RAILWAY ENGINEERING AND MAINTENANCE OF WAY.

WITH WHICH IS INCORPORATED

ROADMASTER AND FOREMAN

BRIDGES--BUILDINGS--CONTRACTING--SIGNALING--TRACK

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CONTENTS.

The Rate Cases.

There seems to be confusion, according to the published accounts, concerning the proposed rate increases that were suspended by the Interstate Commerce Commission last week. The papers state that the Interstate Commerce Commission suspended for four months practically *all* of the new freight tariffs *making advances* in rates which have been filed *recently*, thus including the rates in Central Freight Association and Eastern territory, and also in the territory west of Chicago. The commodities affected by this are live stock, fresh meats, hay, grain, cotton goods, ore, etc., and changes in elevator charges and other local charges are included. As a matter of fact, the rates that have been suspended by the commission for the purpose of investigation until March 31st, 1915, are the proposed increases of western classification territory, the territory west of Chicago. This suspension is according to law and is the limit allowed by law. Included in this suspension, the only rate that specifically affects the railways east of Chicago in Central Freight Association territory, is the suspension of the proposed increase in the grain rate. The proposed 5% increase of freight rates in territory east of Chicago or the Central Freight Association territory and the eastern territory, submitted to the commission in October have not as yet been decided one way or another by the commission. That is, the commission has not suspended them, for legally, according to the wording of the present law, they cannot allow an increase in rates, but can merely investigate and decide on the reasonableness or unreasonableness of the proposed increase. These are the rates that more particularly concern the railways and the railway supplies than any others. It is confidentially hoped and expected that the commission will render their decision according to their legal rights prior to the 20th of this month.

The Boomerang.

It was the fashion five years ago to treat *all* the railroads as criminals on account of the criminal actions of a very small limited few. Regulation was the cry and the order of the day. State and Federal laws were enacted by the score. The result is today the railways are facing one of the greatest financial crises of their history due to the destruction of their credit by adverse legislation. The representatives of the great American people, in Congress assembled, took their cue and for political reasons went after the railways and "made hay while the sun shone." Inasmuch as the business of the railways affects *two-thirds* of our population, in one way or another, the people are beginning to realize that they themselves are being injured and the business of reform has been carried too far. In 1910, when the railroads of the United States endeavored to advance their rates 10%, they were met with intense opposition. Finally, at a conference between the President of the United States and a committee composed of the presidents of the principal railroads, it was plainly intimated to the committee of presidents that unless they voluntarily suspended their tariffs which they had filed with the Interstate Commerce Commission, the United States Government would go to any extent, through injunctions and the application of the Sherman Anti-trust Law, to prevent carrying out of the increased tariffs. Therefore, there was nothing for the carriers to do but suspend the rates, it being part of the agreement that the laws would be so amended that the Interstate Commerce Commission would have the power to suspend rates pending

investigation. The law is very clear upon the point that the burden of proof as to any increased rates is with the carrier and, therefore, any wholesale advance in rates seems impractical.

On the other hand the law seems to be very clear that it is the duty of the Interstate Commerce Commission to pass upon each specific rate.

Undoubtedly the way to have cured this situation, if the people of the United States were intent upon letting the carriers have more revenue, was to have repealed the Suspension Clause of the I. C. C. law; and it would have been feasible for the various interests of the United States, if they felt that an injustice had been done, to attack such specific rates as they desired.

In the decision of the Interstate Commerce Commission in the so-called Five Percent Case, a way is pointed out for the obtaining of increased revenues and specifically leaves the way open for an advance in certain rates. The railroads have been endeavoring to carry out the decision and have filed tariffs showing increases in a great many rates and are still proceeding along those lines. The trouble, however, that has developed is that the state commissions are not in sympathy with the Interstate Commerce Commission and, as a result, a very chaotic condition exists today. Tariffs have been filed by the carriers in an endeavor to meet the views of the Interstate Commerce Commission but in a very great many instances these tariffs have been suspended on intra-state traffic and we are confronted with an advance in inter-state rates and no corresponding advance in intra-state rates. In some cases that works a handicap as some road may be entirely intra-state and another may be inter-state between two given points. The people on the one hand have been endeavoring to increase the powers of the Interstate Commerce Commission and the carriers have religiously endeavored to abridge them. The carriers, as a whole, believe in the Interstate Commerce Commission, but have always felt that the commission should be a judicial rather than an executive body. The commission at every step has endeavored to assume executive powers and such powers have only been granted, under the Constitution, to Congress, but, in order to keep peace, the carriers have not placed before the Supreme Court the question of the legality of the several actions of the commission. Therefore, it seems a very peculiar situation to now be demanding that the commission assume such vested powers as were never constitutional, i. e., to decide the railroad's revenues in bulk and not per specific rates.

The Outlook.

The indications seem to point to a revival of business interest and confidence. Already some of the railways are placing orders for betterments and improvements. It behooves all permanent way men to present carefully prepared budgets of their requirements. It must be borne in mind that "boom times" have not arrived by any means, but only a normal revival. Therefore the budget should be prepared and then carefully revised in order to cull the luxury from the imperative. At this time only the imperative improvement or betterment should be considered and accentuated when appropriation authority is sought.

President Rea on the Railroad Situation.

In another part of this issue we publish an excerpt of an address delivered by President Rea of the Pennsylvania system. It is interesting to note that he recommends strongly an increase in the number of members of the Interstate Commerce Commission and also a change in the personnel, in order to have expert railway men appointed. We have been advocating this strongly for the past year and hope it may eventually bear some fruit. There is no doubt the present commission has more to do than it can effectively handle in the great railway mileage of this country. The number of the commission ought to be increased to 10 or 15 members by the addition of proper railway officials, both operative and traffic, and a representative business man, we would then achieve both efficiency and quick results.

INTERSTATE COMMERCE COMMISSION.

ANNUAL REPORT.

In its annual report to Congress December 10th, the Interstate Commerce Commission makes these principal recommendations:

Laws to control railway capitalization.

Compulsory use of steel cars in passenger trains and prohibition of the use of wooden cars between or ahead of steel ones.

Definite penalties for violations of the hours of service act.

Laws to make explicit and certain the authority of the commission to examine all documents and records of railroads.

To definitely fix a period—preferably three years—in which legal actions may be started relating to transportation charges.

REVIEWS WORK OF YEAR

All the commission's recommendations are made in extraordinarily brief form and without discussion. Otherwise, the commission's report is a chronological review of its work of the year.

The work of physical valuation of railroads is well under way. With the coming of winter, the field parties are being transferred from northern roads to those in the south. There are now eight parties at work surveying about 1,500 miles a month. The number of parties will be increased on January 1 to about twenty for each of the five districts.

At some length the commission reviews its investigation of accidents. Collisions caused by improper flagging continue to be a prominent feature of those investigations, the report says, and cases of inexperienced men have been found. The number of collisions due to enginemen failing to regard block signals has decreased.

CONDEMNS TRAIN-ORDER SYSTEM

"The inherent weakness of the train-order system continues to manifest itself as a prominent feature of the accident record," says the report, calling attention to the need of legislation to make standard operating rules.

The general movement among the railroads for higher freight rates the commission dismisses with a brief review of the proceedings in the eastern advance case which it decided last August, and which is now again awaiting a supplementary decision.—*Associated Press Telegram.*

SAFETY ON RAILROADS.

The Pennsylvania system in the six months ended July 1, 1914, carried 87,000,000 passengers, almost the total population of this country, and not a single passenger was killed in a train accident. Again, in the calendar year 1913, the lines of the Pennsylvania east of Pittsburgh carried 108,000,000 passengers, more than the entire population of the United States and its dependencies, and not one person was killed in a train accident. A record such as this is excels any other method of transportation ever devised, far surpassing in safety travel on foot. The perfect record of the last six months involved the operation of 680,000 passenger trains by day and night, and through fog, snow, storm and clear weather. The New York Centrail railroad may point to a record fully as fine. In the three and a half years ended July 1, 1914, not a single passenger was killed in a train accident. During this time 819,513 freight trains and 1,266,654 passenger trains were operated, the latter carrying 136,154,983 passengers.

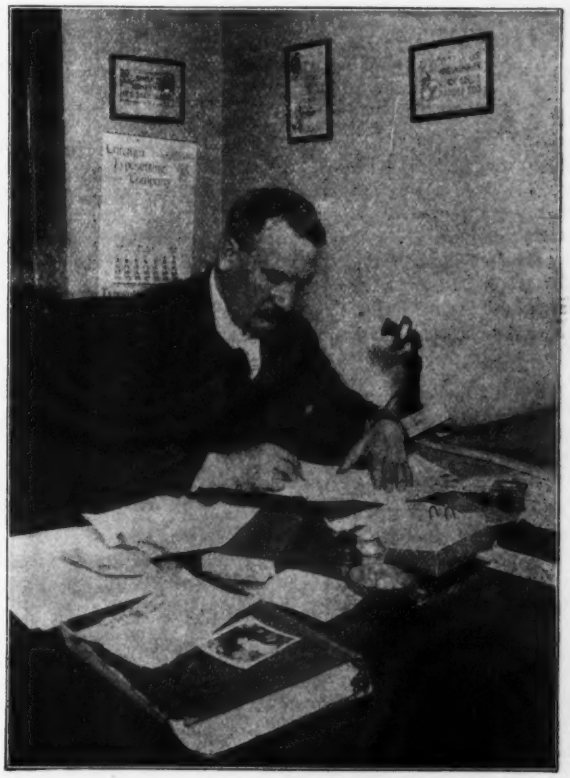
WILLIAM E. MAGRAW.

William E. Magraw, president of the Railway List Co., Chicago, Ill., died November 24. He was taken ill with appendicitis Thursday morning, November 19, and was operated on the same day. Conditions seemed favorable to recovery for the first few days but peritonitis set in and he passed away at five o'clock Tuesday.

Mr. Magraw was born at St. Peter, Minn., May 3, 1858. At an early age the family moved to St. Paul, where Mr. Magraw received his education and where he was engaged in newspaper work for many years. He came to Chicago in 1895 and after a short time spent in trade journal work, he became associated with the *Railway Review* as western advertising manager. In connection with this work he later became an officer of the Railway List Co., having purchased the *Monthly Official Railway List*, which he enthusiastically pushed for many years. In the spring of 1909 a reorganization of the Railway List Co. was effected and Mr. Magraw, who had been its president for some time, continued as president, with the *Railway Master Mechanic* added to his responsibilities. *Railway Engineering and Maintenance of Way* was adopted by the company in the fall of 1909 and since that time Mr. Magraw had devoted all of his tremendous energy to the development of all three publications, which he found pleasure in designating (from the colors of the covers) the "Red, White and Blue."

Those associated with Mr. Magraw were, of course, aside from his family, in the position to appreciate the sterling qualities not at once apparent to others who were fortunate in his acquaintance. His greatest fault was extreme generosity. He was actually ashamed of it and would attempt to place the credit for his various generous acts elsewhere. A person who had once befriended him in any way had a lien on all Mr. Magraw possessed provided he needed his (Mr. Magraw's) assistance. In times of adversity Mr. Magraw's smile or gentle joke was always in evidence. He worried much because he wished to save others worry, his family most of all. Himself a high principled man, a lover of frankness, loyalty and truth, he could not condone dishonesty or disloyalty in others. Aside from his family, Mr. Magraw had no other interests but his business. He did not take vacations because he could not enjoy them. He spent practically all of his time at his home or at his office.

Mr. Magraw married Miss Lida Marshall on October 6, 1887. Four children were born to them, two dying in infancy. The sorrowing widow and two daughters, Elizabeth and Ruby, survive to contemplate what to them appears a desolate life, robbed of the care of the kindest of husbands and fathers.



William E. Magraw.

THE RAILWAY RATE CASE.

The decision of the Interstate Commerce Commision in the five per cent increase case comes far from solving the problem of American railroads. The increase granted will bring some additional income to the railroads operating within the favored territory, but the income thus gained will not be sufficient to offset the ever-rising cost of operation, nor will it be of such magnitude that the investing public will be guaranteed fair return on railroad securities.

After having the petition of 112 eastern railroads, embraced in what is known as Official Classification Territory, asking for a flat five per cent increase in freight rates under advisement for more than a year, the Interstate Commerce Commission handed down its decision. An increase of five per cent on sixty-five per cent of the freight traffic was allowed to those roads within the Central Freight Association Territory. This in itself constitutes a moral victory for the railroads and gives promises of better treatment at the hands of the commission in the future, since it is a practical reversion from the popular restrictive policy pursued by the Commerce Commission since its establishment. It partly carries out the assurances of the railroads in 1912 by Chairman Prouty of the commission that if the time comes when it will be necessary to allow some increases in transportation charges it will be the duty of the commission to permit that advance.

But the victory, if it can be termed such, from the viewpoint of the railroads is entirely a moral one. The railroad problem is too far-reaching to be solved by slight increases in freight rates. The attitude of the public and the Government must be changed from suspicion and distrust to confidence and liberality.

If the investing public is not assured of a fair return on railroad securities, new capital will not be forthcoming and the railroads of the country will be unable to make improvements necessary to handle constantly increasing traffic. Either rates must go up or wages, which have been repeatedly raised by successive arbitrations with labor unions, must come down. One thing is certain: an industry cannot be oppressed beyond the point where it is profitable.

In 1900 it cost the carriers 64.62 cents in operating expenses to get one dollar in revenue. In 1913, the carriers were forced to expend 71.77 cents to obtain one dollar in revenue. Cost of operation had gone up and rates had come down. If the cost of operation had remained permanent in 1900 the revenue of the petitioning carriers in 1913 would have been $100,000,000 more than it was.

If the railroads are being looted, as the popular expression goes, it is not difficult to find economic laws and Government restrictions that are becoming so oppressive there will soon be nothing left to loot.—*American Industries.*

Twenty Years Ago This Month

From the Files.

Mr. L. G. Mickles has been appointed superintendent of bridges buildings under Chief Engineer J. F. Hinckley of the Choctaw, Oklahoma & Gulf road.

Sir Charles Rivers Wilson, who has been selected to visit the United States in behalf of the English holders of Central Pacific securities, sailed from Queenstown November 22.

Mr. Edward Clark, who as resident engineer had charge of the construction of the Britannia tubular bridge over Marai Straits, has just died in England, aged 80. He was the inventor of the block system of railroad signaling; he patented the hydraulic graving dock and the hydraulic canal lift, and was for many years the chief engineer of the Electric Telegraph Company. He constructed the harbor of Callao in Peru, as well as other great engineering works in various parts of the world. He was a brother of Latimer Clark, the electrical engineer and contractor of submarine cables.

Mr. Alfred Walter, general manager New York, Lake Erie & Western, has resigned, and will, it is reported, succeed Mr. E. B. Coxe as president of the Delaware, Susquehanna and Schuylkill road.

It is understood that Mr. J. H. Kain, formerly chief engineer of the Mexican Central, will take charge of the chief engineering department of the Milwaukee Railway on January 1.

Mr. Lee S. Overman, who was speaker of the last North Carolina house of representatives, has been elected president of the North Carolina Railroad to succeed W. F. Kornegby, deceased.

Mr. R. H. Hilyard has been appointed superintendent of track, bridges and buildings of the Fort Worth & Rio Grande Railway.

Henry L. Bristol, one of the ablest civil engineers in the west, died at his home in Chicago, Nov. 30. Mr. Bristol located in Chicago in 1848 and was employed by the Old Carolina Railroad. In his capacity as engineer he assisted in unloading and starting the first locomotive that entered Chicago—the old "Pioneer," which was shown at the world's fair.

Mr. Charles H. Ellis, a civil engineer of Detroit, Mich., died at his home in that city November 30, from the effects of a paralytic stroke. Mr. Ellis began his career in the Fitchburg Railroad. Since moving to Detroit about 20 years ago he assisted in building the railroad lines from Detroit to Butler and Bay City. He was also chief engineer of the Fort Street Union Depot Co., and the Detroit Railway & Station Co., and supervised the building of the Union depot, the viaduct and other improvements in that city.

Count Ferdinand de Lesseps, the builder of the Suez canal, died at Paris, France, December 7, after an illness of many months, aged 89 years.

The Tiemiens-Abernethey system of electric fog signaling apparatus is described, in the *Railway Review*, as applicable to locomotives of the English Railways. (This is one of the original "cab signals" to be experimented with.)

Mr. R. T. Morrow, assistant engineer of the middle division of the Pennsylvania Railroad, has been promoted to be assistant engineer of the Elmira and Canandaigua division. Mr. George B. Beale will succeed to the position in the middle division.

Mr. Richard Newell, jr., chief engineer of the Midland Terminal Railroad, was shot and instantly killed December 19, at Cripple Creek, Colo., by a man named Van Houghton, with whom he had some trouble over a right of way.

Mr. Charles F. Mayer was re-elected president of the Baltimore & Ohio December 19.

John M. Felton, C. E., who assisted in locating the line of the Pittsburgh, Fort Wayne & Chicago, died at Valparaiso, Ind., Dec. 19, aged 60 years.

Mr. Robert S. Seibert, general manager of the Nevada Southern, has been appointed receiver of that road.

STANDARD MILEAGE AND SEA LEVEL DATUM FOR RAILWAYS.

The railways have been remeasuring and re-establishing sea-level data of their permanent way for some time and have done more of this type of work within the past five years than for some years prior. To get actual sea-level datum is a more or less new idea, as heretofore this has been gotten approximately with a known or acknowledged error of 10 per cent, or has been established by the use of aneriods rather than by levels taken from a known branch work of the United States Geodetic Survey or other acknowledged official survey. To arrive at correct levels and establish permanent track marks along the line of a railway is not only a painstaking and difficult plan of engineering, but is a most expensive one. With the best of care, under the usual organization allowed for this work, errors will creep in, and, of course, as the work progresses along the line they will accelerate. To add to the confusion the bench marks of Government surveys are not always accurate or check with surveys made at different times and by different Governmental Departments.

The majority of the railways have had their lines remeasured, and a standard system of mileage established and substantial mile posts set to mark the mile points of distance along the roadway; and they have also rerun the base of rail levels to a sea level datum, and replotted the profiles. But there are yet a large number of them, probably 40 per cent, that still have equations to put in their mileage, and are still working with profiles on every conceivable datum. It is for the benefit of those in charge of this latter class of railways that this article is written to give the cost and the actual experience one railway system had, within the last four years, in remeasuring its lines and rerunning levels to a sea level datum.

The advantage of having a standard mileage for distance and a standard datum for elevations is so apparent we will have little to say. Every freight agent and passenger agent wants to know hundreds of times a month just how far it is from one point to another without having the bother to add or subtract something extra.

Up to a few years ago one man in the engineering department was doing little else than answering telephone calls from the traffic men as to how far it was from the entrance to a certain freight yard across the river, to a freight depot on another division, and while some of the questions might seem ridiculous, they were really puzzlers, even to the draftsman who had the mileage in charge. Now some roads have issued a book which states a standard distance for every point of swith, road crossing, ice house, coal dock, milk station, etc., on the line, so that all any agent or official has to do is to subtract.

The engineers themselves while in the field taking levels or remeasuring would often get into difficulties, for when wiring to headquarters for information would receive enigmatical replies, as, "Eastern division datum 34.22 lower than Southern division. Northern division 18.19 higher than Western division." As a result of these experiences one engineering force remeasured the whole system and reran the levels to the standard sea level datum.

But they found the job was no easy plain-sailing piece of work; they made many mistakes, ran into many difficulties, and it is of these the profession should be warned by stating a few facts of actual experience they had on the remeasuring and relevelling of this system.

In the first place, unfortunately, there are all sorts of sea level datum, and it is no easy job to determine what is the mean sea level of the ocean, with the rising and falling of the tide. In the early days of the Northern Pacific one party of engineers took the sea level datum from mean tide at Seattle, and another party took it from mean tide at Tacoma. The result was an equation of some 9 feet, Tacoma mean tide is 9 feet higher than Seattle, and as late as 1902, when I was a draftsman on the N. P., we used to have to struggle with three equations at Tacoma, all arising from the engineers not knowing enough of the business to get the mean sea level.

If anyone wants to look up the subject of tidal planes, the

United States Coast and Geodetic Survey has issued several books concerning it and they may be purchased from the government. Until a few years ago there were three sea level datums in this country, but fortunately now they have all been reconciled. They were the datum of the United States Coast and Geodetic survey, the United States Geological survey, and the United States Mississippi River Commission, or the War Department.

The United States Geological survey now has very reliable bench marks scattered throughout the United States, and their correct elevations may be had by writing to that organization in Washington. These bench marks are, as a general thing, iron posts 4 inches in diameter set 3 feet in the ground with about one foot showing above ground; or, copper tablets inset in some public building. Often they have the elevation stamped on them, but take care; we have found that these figures are not always reliable, sometimes the man who did the cutting got a 9 for a 6, and some of the marks were stamped years ago, before the three government organizations agreed on the mean sea level, and some of them are only marked to the nearest foot. So one should write to Washington. Better write to all three organizations about the same bench mark, as we found an isolated case where the correct record was not kept up to date. In a large number of cities along the interior rivers of the country the United States Engineers have an office, and in passing through one of these cities never omit to call on the officer in charge and get the latest information. Often bench marks have been known to seattle and only the local officer in charge of the district knows of this. Its settlement has been reported, of course, but has not made its appearance in the errata of the official publication in Washington. The U. S. P. B. M. on the tower of the Illinois Central depot, at Dubuque, Iowa, has settled 0.20 of a foot, and had not Major Edwards warned us of it, we would have been a long time checking on it. U. S. P. B. M. means United States permanent bench mark. Then there is a U. S. P. B. M. for temporary bench marks.

As we made many mistakes of judgment and errors in the course we pursued, we are not at all proud of the work, but in order that others may profit by the lessons we learned we will give actual distances, actual errors in instrument work and actual cost.

In the first stages only one survey party can be used on the work until some junction point of another division of the road is reached, because it is desirable to have only one zero; you cannot start another survey party, some 500 miles ahead, until the chaining is brought up to that point, for you don't know the distance, and if you guess at it you have an equation and then you are back in the old rut. After you reach the parting of the ways, where another division branches off you can work two parties, and, on a large system that has a number of branches and main lines, several parties can be employed in the later years and hasten the closing of the work.

In the first place, where does the road begin, where is the zero point. At the bumper post, of course, if it is a stub terminal. But if it is a lap terminal, freight yards behind the start of the passenger depot, don't turn the chainmen loose on the job until the head officials have decided on the matter. We decided that freight mileage is the standard mileage, but the question is still open for argument. We sent the chainmen down uninstructed to "begin at the depot," and they were back up in the office in less than an hour for more explicit instructions, and we afterwards held the work up a week to give the officials a chance to decide on it.

Again, it is not always easy to decide which route to follow at a junction point, as for instance in the figure. In this case the chainman, under the direction of the assistant engineer, followed the "high Y," or most direct route, but not the most used route. This was not thoroughly considered by the chief engineer until we had measured some 351 miles of the "West division," a whole summer's work, then he ordered it changed. We have changed it in the notes and on the profile, but we have yet to change the mile posts, an equation of 4,027 feet.

Poor chaining was often a source of worry. The exact measuring of each hundred feet and the exact marking of each mile is not well understood by the average pair of chainmen. A standard mile should be measured along a handy piece of tract and each pair of chainmen tried out on it. This mile should be measured "for keeps" with a standard tested tape, with inset thermometer and spring balances attached. A standard tape of this kind has a screw and scale movement for temperature adjustment. It should never be used in the field except to establish a standard, and in the hallway of the headquarters office building to test the field tapes. We also issued a blue print sheet of corrections for temperature and corrected every 1,000 feet.

We got the best results, chaining mile after mile, by laying the tape on top of the rail, and marking with fine pointed yellow crayon. Chaining pins were not as accurate though we used them on curves where we had to follow the center line. We changed from the rail at the beginning of the curves simply by holding the rear end on the mark on the rail and the head end in the center of the track. The error in making this move over from the rail to the center is about 0.01 of a foot.

On one division of 252 miles we marked every 1,000 feet by a hub set at right angles 10 feet out. This was a good hub three feet long. After this first 252 miles we adopted the system of painting every 1,000 foot point on the inside of the web of the rail, using any prepared white enamel. After many experiments with different kinds of paints, white enamel was found the best. It drys before the next train can smear it with dust, and it remains as long as the rail remains. But both of these methods of marking have gone to the bad so far as we are concerned. Bulldozers, gravel spreaders, and ditchers have knocked out most of the stakes that were set 10 feet out, three feet long though they were, and with the putting on of heavier steel, our old rails have been taken out and with them went the white paint marks.

If we had it to do over again we would send another party following up the chainmen, and with transit set in iron posts at right angles, 50 feet out on each side, or at the intersection of the right of way fence. There are miles of our line now, after we have spent thousands of dollars, that have not a mark on it. On two divisions covering some 400 miles, we set the year following, large concrete mile posts, 10 feet long, 4 feet in the ground. But, unfortunately, they were set by the section men, and many of them are not in true position, though generally within a foot or two, some of them are out a hundred feet. An assistant from the chief engineer's office should have been present at the setting of each one.

The same can be said of the cast iron, gaudily painted, county line signs, fully a third of them are set wrong by the section foremen, either out of line, or have the county names reversed, so that while you are in Muskingum county, you are confronted by the words "County of Prairie" on the sign.

In draining it is only the exact distance and the one track that are concerned. Points of switch, points of frog, ends of depots, faces of abutments, culverts, etc., should be noted, but more extensive notes are not needed. We are only chaining, not making a complete survey. Yet as the chainman can easily make greater speed than the leveller, they will find plenty of time to make very neat and quite extensive notes. They should not get further than easy calling distance from the leveller for they are sure to make a mistake in numbering the stations at least once a week. The leveller, of course, will find this out and raise a fuss, and they should not be so far away that he cannot call them back to correct it. If a situation should arise that it is very necessary for them to chain ahead, a set of chaining pins should be used for keeping tally only; properly used it is then impossible to make a mistake. But so many chainmen are unreliable enough to slight this feature, and trust to their own memory for numbers, therefore, it was found safer and better to keep them close in to the level party.

In making this survey the party consisted of a leveller, rodman and two chainmen and a motor car. In the winter when we were setting hubs in the frozen ground we had two extra men to do the digging. We now know it would have been far better to have had one man with a transit and a stakeman, and driven iron pins 50 feet out. For the first 116 miles we had a second level party

party follow up the main outfit, and check the results. We afterwards discontinued this practice. They did not check, for both of them made a 2-foot error at the same place. It was probably a rare case of bad luck. This afterwards caused us a great deal of trouble, for the error came right about the middle of where we afterwards laid out a new yards and the work was well under way before it was discovered and some serious changes in the grades of the yard had to be made.

As to the pay of these parties, remember we were at the work three years and there was no one man remained from the beginning to the end. We had men of all grades, old men, young men, experienced and inexperienced, but I do not mean absolutely green, none of them but who had been instrument men for three years previously.

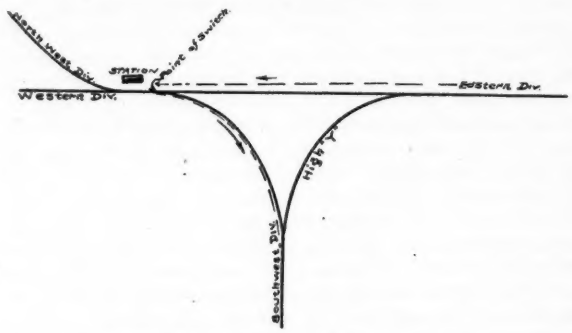
But the grade and the pay did not seem to make much difference in the levelmen. Men at $75 a month did as good work as men at $150. The best work was done by a man at $90 and the next by a man at $125 a month. In all, we employed 12 different men during the three years. But in chainmen, experience and pay counted a great deal. Some chainmen were paid as high as $75 a month, and we received in return accurate chaining and extensive and neat notes.

The authorities decided that regulation 22-inch plain "Y" railway levels were good enough and two new ones were purchased at $125 each. With this begins a tale of woe, and we started on an expensive piece of work inadequately equipped. If we had it to do over again I would use more insistence that we have instruments of true precision, equipped so that the bubble could be seen at the time of sighting. After watching the results of 12 different degrees of men handling these two instruments I am convinced that ability counted for little, that the results we obtained were gauged by the accuracy of the instrument.

We arrived at Memphis, 172 miles, 0.02 high on the government bench mark, and everybody was shaking hands with everybody else, and there was an air of "I told you so" among the authorities in regard to the instruments, but then they did not know anything about the 2.0 foot error back toward the other end. From Memphis north I took the instrument myself and within 23 miles I was out 0.07 high on a government bench mark. We were five days on that 23 miles, sights 300 feet each way from the instrument. I felt that I was running off, that I could not be sure that the level bubble was centered at the time I sighted. I then dropped back to the B. M., at the 23-mile point and started over again, this time I had the rodman watch the "gun" while I read the rod, and we changed about on this, using one of the chainmen as rodman. At the next government bench mark we were the same 0.07 high, but there had been two men at the level, and that made it expensive enough to buy another and better instrument. Since the work has been finished I have often had suspicions that the slow speed some of the parties made was because they had two men at the instrument, one to sight and one to watch the bubble, but of course, in the office we had no control of them in the field. I say 0.07 high, but at the time it appeared 0.86 high, as I had no knowledge that that particular bench was only marked for the nearest foot. We immediately started a check level party out over the same ground. He weaved over and under mine some 0.20, arriving at the end 1.02 high, and then after a month we got word from Washington what the true elevation was and by it I was 0.07 high.

As for rods, we used a great many different ones and kinds, all target rods. As yet I have not any choice, but if we had to do it over again I would not use a rod that had not been tested at the Bureau of Standards, Washington. We got hold of one that was actually bad, but fortunately, we were running check levels and soon found it out. We had sent it to the paint shop for repainting and they had taken off the brass scales and in resetting them after the painting was done they had gotton them on wrong. I believe every engineer's office of a large system needs an appliance for testing rods, or they should not be taken apart and reassembled without afterwards being tested at the Bureau of Standards.

As stated, we arrived at Memphis 0.02 high, but there was back of this an error of 2.0 feet. We arrived at the Missouri river 1.66 low, distance, 159 miles, and at another point on the Missouri, 2.14 high after a run of 263 miles. All these were carefully check leveled and it was just about the best that could be obtained from the grade of levelling instrument used. But the worst was at Cairo on the Ohio. We were 3.40 high there. The level man, at a salary of $125 a month and 14 years' experience, dropped back and reran his levels, and found, much to his disgust, that he just weaved over and under his original runs.



Example of Survey at Junction Point.

The most deplorable result of this error is that we have the past year built a new bridge over the river to our datum, of course, and the Union Depot Co. has another datum. Now they have planned a new depot and expect us to come up on the second story with our passenger trains. They have laid the ascending grade to this second deck on what should be our right datum, and now there are some of us wondering if we can clear the top chord braces of the bridge. This is only one of the many cases we have to puzzle with, but it is one of the most serious. It is a pity that since we started out to do a thing right that we did not equip ourselves for it and do it that way.

As for the chaining, we had a number of checks. The best run was 246 miles: difference between the two sets of chainmen, or you might say the measuring of 1903 and the one of 1910 was 29 feet. On the whole, the chaining did not vary greatly after we got the men who could do it right.

The methods of leveling pursued were as follows: sights 300 feet long each way from the level; level was set up over the rail; turning points were on the rail; the stations the base of rail or top of tie. Of course we knew the rating of the instruments, the degrees of arc of the bubble. A target rod was used and the rodman kept a peg book. The distance run each day varied greatly, but I should say that 2.5 miles was a fair average. The longest day's run was 7 miles. Often the party would run 30 miles or so and then drop back and run check levels. Nearly the whole line, where there was any discrepancy arising, was check leveled. There were many days when it was too windy and some when it was too cold or rainy, so we cannot make a definite statement of the average mileage.

The expenses of the men in the field were paid by the company, and they boarded at farm houses or used their motor car to run into the nearest suitable town. Expenses averaged $47 per month per man. The average cost per party of 4 men was $448 per month. The number of miles run was 1,462. The total cost of the work was $16,118. This does not include the cost of the concrete mile posts or of the gasolene for the motor cars.

The Atchison, Topeka & Santa Fe has given the Leyden-Ortseifen Construction Co., Chicago, a contract for the construction of a one-story reinforced concrete storehouse at Albuquerque, N. M. This road will build a $50,000 addition to employes' hospital at Temple, Tex., and will construct a traveling hospital car to cost $15,000.

The Chicago & Western Indiana will construct a $100,000 addition to the Dearborn station at Chicago.

RAILROAD VALUATION.

By H. H. Edgerton, Assistant Engineer, Chicago Great Western.

Railroad valuation is a mole hill that develops into a mountain, and not a smooth conical mountain either, but one with spurs, precipices, and subterraneous caverns. At present the Interstate Commerce Commission is in one of these caverns, and they do not know the size of the mountain on top of them.

There are many different kinds of value to a railroad mainly depending on the purpose for which the valuation is made; for taxation, speculation, hauling capacity, rate making, etc.

SPECULATIVE VALUE.

Some roads are so situated in their relations to other roads and commercial centers, that as long as these relations exist they pay good dividends, and this is reflected in the selling price of their securities. The case is illustrated by some belt lines, coal roads, etc. Their returns are good as long as it best suits the two controlling ownerships to have it that way, and it is a speculation how long this condition will last. This is entirely outside of stock gambling speculation. We have nothing to do with that.

STRATEGIC VALUE.

The occupation of certain territory in such a manner that it is nearly impossible to parallel them by other lines, or to reach the same territory by somewhat divergent lines. There are many cases of this kind, as for instance, the New York, New Haven & Hartford's Long Island Sound line; the two Hudson River lines; the Denver & Rio Grande's position in the canyon, etc., etc. It is worth something to be in a position that can not be duplicated, and this condition has a value.

HAULING CAPACITY VALUE.

There are a number of roads so situated that they can haul between two points much cheaper than competing lines. This has a value to it, and there is no way of getting around it. Temporary schemes and other routing may maintain adverse conditions for a while, but the cheaper haul, the one that burns the least coal, will survive in the end. There are so many cases of this kind it is hardly worth while to cite any of them. The Chicago, Burlington & Quincy line along the Mississippi river is one of them. They possess a superior advantage in cheap haul on account of nearly level grades following the river which their competitors do not, and this condition has a value. It also has an example on a smaller scale in the prices of rents in a city, so these examples are all around us and the condition is apparent to everyone.

THE PHYSICAL VALUE.

It is pretty well settled that this is to be the cost of duplication or reproduction, though this is only a fairly safe basis, and there will be some almost absurd situations arise. For instance, the prices of certain kind of track material are much cheaper now then they used to be, owing to improved processes of manufacture, so that after bettering the line by replacing the worn out with new and heavier rail, the additions and betterments account will show a loss instead of a gain. There are a number of cases where a railroad has invaded a residential suburban district and bought up land and established a freight yard, when at that time high prices had to be paid for the land. Now that the railroad is there, and has on account of smoke, noise, etc., made the neighborhood undesirable for residences, so that if the road needed any more land they could now get it much cheaper than they could say 20 years ago. The question now arises, what is the value of the railroad estate; is it the value that they paid for it or is it the value of the adjoining town lots?

Then there are two forms of physical valuation; cost of reproduction new, and cost of reproduction less depreciation.

COST OF REPRODUCTION NEW.

The cost of reproduction new, what it would cost to build new as it now stands, is one of the methods laid down by the act of Congress authorizing the Interstate Commerce valuation. It is also one of the most favored by the engineering profession, because it eliminates the troublesome feature of deducting for depreciation. In compiling what a road would cost if built anew again, one should attempt to follow out to a certain extent the steps that were taken in its original construction, and consider the condition under which it was built. It is unfair to consider that a road could get its material delivered along its line by other roads, when those other roads were not built at that time, and there was likely a heavy expense for carrying forward the material. It is not intended though that the prices that governed in the early days should hold now, for ties may have been 10 cents and labor $1 a day. It is the cost of reproduction new, and now.

COST OF REPRODUCTION LESS DEPRECIATION.

This is also one of the methods mentioned in the act of Congress, and it seems a very stale way of doing. It brings it up to the day and date, but a new valuation will be needed a year hence, and depreciation seems to be one of the losses assumed by the stockholders in every corporation, and is expected to be provided for in the operating expenses.

If for any reason it is insisted upon, elaborate depreciation tables will be necessary to make the proper deductions. These, of course, can be compiled by taking the life of ties, of locomotives, and the probable life of buildings, etc., but in some cases it has a nasty lot of probability in it, and especially in the life of buildings it will depend on the maintenance operations, how often they paint and how often they reshingle. For every road there will have to be a special set of depreciation tables to suit their conditions, as ties that would be perfectly serviceable in one dividend-paying plant would be ruinous to use in some other transportation plant, and the same may be said of rolling stock, depots and other facilities; what might be scrap on one railroad could be utilized on another, and would have a different depreciation rate.

Since physical valuation is going to be the main issue, the thing that is now uppermost in regard to it is the cost of making it. Many roads have not yet begun, and those that are at it have not seen the end. There are many different methods of procedure, all the way from shiftless to thorough, and a moderate classification of these methods of making a physical valuation here follow:

CLASS 1.

On paper, in the office only, cost per mile.....$8.00

The above cost of $8.00 per mile is based on taking it for granted that the road already has profiles, station maps, right-of-way maps. The amount of material in the cuts and fills is calculated from the profile, presuming that the cross sections are level or correcting them by slope angles where they are known not to be. At the best it is a loose method; many things may be overlooked that are not shown on the records, and the result is likely to fall 25 per cent short of a more thorough method. Roads which have not a complete outfit of profiles, right-of-way maps and station plats will have to do field work and spend more money per mile.

CLASS 2.

With field inspection of track and structures, cost per mile..$16.00

This field inspection will be very light; to include merely the walking over the line by three men to check up frogs, switches, track material, buildings, etc. It adds a good deal to the value, for it is surprising to find how many things are omitted from the standard yard maps, etc.

CLASS 3.

Field and office work combined, cost per mile.....$30.00

This will include the measurement of the widths of the cuts and embankments, and though they are only measured on the base, the method will add largely to the value of the roadway, and will bring the results to within a small per cent of the right amount. It will also include a count and a check of the track material and buildings. But there will be no time for regular cross sections of the roadway.

CLASS 4.

Actual measurements of cuts and embankments, cost, mile...$65.00

This based on the assumption that the right-of-way maps and station and yard maps are fairly well up to date. It does not give the margin that is necessary for complete valuation.

CLASS. 5.

Complete physical valuation, cost per mile.....$75.00 to $125.00

This means actual measurements of cuts and embankments, yards, terminals, track material, structures and real estate, and

a careful consideration of all the steps necessary to build up a working transportation plant.

CLASS 6.

Government valuation, if they do not change their ways, per mile.....$250

TABLES OF UNIT PRICES.

The first step, and almost before the organization of the working corps, is to establish a list of unit prices. This table should include everything used on a railroad, excluding possibly the mechanical department, which should be a separate volume, and if properly done it will be an indexed book of many pages. Tables of other roads, and the purchasing agents' and storekeepers' lists should be freely consulted, as no man can, from his own mind, compile one. In it should be stated the cost of excavation, masonry, ties, switches, rails, etc.—everything used on a railroad, and that means a good deal. These lists of items should be typewritten on tracing cloth with several columns for prices on the right of the page. These latter are necessary for the placing of the dollars and cents in which changes may have to be made. The space should be ruled and left blank, and the dollars and cents afterward written in by hand on the white prints made from the negatives of these tracings.

Each division will likely require a separate statement of prices as these will change somewhat with the locality; ties will be cheaper in Washington than they are in Dakota, and excavation of earth costs much less on some parts of a system than it does on others. A number of these volumes will be necessary for each force on each division, so the men will not have to wait on one another for the use of a book.

WHAT IS TO BE VALUED.

To say what is to be valued is impossible, the list is too long and complicated; the history of the work only can show up the steps that were taken, the costs that arose in connection with it. To reproduce the plant is of course the essence of the instruction, but even this is not as simple as it seems. Before attempting a valuation the engineer should have been a long time on railroad construction to know the process of producing mile after mile of a transportation plant, for if he is not such he will just estimate what is apparent, and overlook the many auxiliaries that were at one time necessary steps in the construction. A few of these are mentioned from a long list, and often it will become a matter of judgment what is right and proper and what is not.

Temporary trestles and bridges were necessary in the cases of some long roads, by this is not meant those small affairs used to make large fills; they should be included in the price per yard of the embankment, unless they were very large ones. But those trestles and temporary bridges were necessary for river crossings, so that the road could be shoved on ahead to get supplies up at the front, and perhaps partially put in operation to help pay the fixed charges on the capital invested, until permanent bridges could be put up. Without such temporary trestles and bridges, long lines of road would be many years in building, and in the meantime the interest on the money invested would eat up the enterprise. All such structures, though they have long since disappeared, are an essential part of the cost and should be included in the valuation.

Also include temporary material yards. All long roads require them well up at the front, and without them chaos results in the forwarding and distribution of supplies. Though pulled up and abandoned, so that sometimes hardly a trace of them can be found now, the valuator should become a sort of historian, and write up as nearly as he can their probable cost from such information as can be gathered from old maps and profiles.

The same can be said of switchbacks over mountain passes, sometimes used for many years until a tunnel was built. They were a necessary part of the enterprise, and would be one of the essential steps if the railroad was reproduced again.

Ditches to drain swamps, dams to raise rivers, so that timber might be floated down, or supplies brought up; and water supply works, etc., are often essentials costing money, and have frequently been works of such magnitude that they were not included in the price per yard of the roadbed, and therefore should now appear separately valued as part of the cost of the plant.

The cost of what turned out to be experiments or temporary lines now abandoned, even though used for many years, should be included in the value of the road. Under such heading would be included places where a mountain continued to slide or a swamp continued to settle, so that a new line had to be built. There is, however, a chance for a difference of opinion here as some contend that cost to reproduce the road as it now is should be rigidly adhered to, as the allowing of any leeway from that leads to the inclusion of now abandoned strips of roadway built for some ulterior reasons and not for experiment or temporary expediency. For instance, it has been said that for a short period the policy of one administration of a subsidized transcontinental line was to build the road more crooked so as to take in more of the government land of the alternate sections donated to them for 20 miles on each side of the line, and they figured on straightening out their road after they acquired title. Then again there is the case of a director casting the deciding vote in the adoption of an alignment that would enhance the value of certain real estate in which he was a silent partner. Then there is the doubtful practice of deviating the alignment so as to reach certain boundaries, and prevent the subsidizing of another road adverse to the interests of one of the directors, but not to the project in question. These are some of the arguments that are presented by those in favor of valuing a road as it now is, without regard to some of the many expenditures for abandoned track that was once a necessary part of the whole.

While this matter has been dealt with by the Interstate Commerce Commission, there is a strong sense of justice that if the deviation was known to have been made for other purposes than legitimate transportation, the property value of the road will have to suffer a loss the same as if the money was purloined from the treasury by more open fraud. See "Accounting for Abandoned Property," Interstate Commerce Commission, Feb. 10, 1912. Public document.

SOME ITEMS TO BE CUT OUT.

An item which should be deemed improper is the 6 per cent or 10 per cent of the total cost paid to some contractors simply for the use of his office and name. This view differs from that of Mr. Wilgus, who holds that large undertakings require large contractors (sometimes large in name only) to undertake the construction of a long line of railroad. If he furnished all the plant or money this head contractor might be worth the price, but too often he owns nothing but an office, and is without machinery, plant, or capital; pose and ability to handle the board of directors are his main assets. He lets out the work in 10 or 20-mile sections, and receives 6 per cent on the prices of his subcontractors. There was one case where a head contractor did not even have the expense of checking the payments, handling the payrolls or monthly estimates. All he wanted to know was the total amount and collected 6 per cent on that; the subcontractors furnished the capital, plant and responsibility. To enlarge his office into a lounging room, install some easy chairs, and entertain the board of directors were all the visible additional efforts he entered into. In the construction the chief engineer's office could as well have attended to the apportionment and letting of the work in suitable sized contracts. And this 6 per cent sometimes has amounted to a million or two of dollars. The whole arrangement smacks of a "blow back" to the directors or officials who sanction such an arrangement.

And in this manner of procedure the expense has not been limited always to as low a figure as 6 per cent. Many and varied are the wheels within wheels of construction companies that receive so much per mile, and various classes of bonding and underwriting arrangements which increase the cost unnecessarily. Some of them, however, are absolutely essential; this only applies to those who do not give value received.

The value of a franchise should be omitted in a physical valuation if it came as a free gift from the state or municipality. It should not be figured as part of the capital of the road, and

used as part of the investment upon which rates are based; "the public expects to pay no taxes upon that which they gave freely."

"Good will" does not properly concern a physical valuation, but even in the final balance sheet handled by others than the engineer it is doubtful if it should appear, as there is a question as to its existence, and no measure of its limits. Good will in the railways' case simply means the advantage to ship. Let the rate be lowered by another route and see how long it will last.

In the matter of value of streets crossed or occupied by the railway; if this was a free gift from the public it should not be accredited to the capital account. Also overhead highway bridges, if the item was paid for by a municipality, and not constructed by the company, it comes in the same class as the crossing facility of a foreign line.

OFFICE FORMS FOR VALUATION.

Most every railroad system will require some special variety, but the best forms up to date are those arranged under the direction of Mr. E. Holbrook for the Union Pacific system. A road just starting in on a valuation would do well to follow them with such additions as may seem necessary for their own special case, and all valuation engineers who are now conducting a work, if they would examine a set of them may get some surprises to see how well and thoughtfully the compilation of data has been provided for, and be able to correct some bad arrangements and oversights of their own. The height of perfection is the arrangement of the data to take care of the past, the present and the future; to so arrange the summaries of quantities so that the original amounts, development cost, appreciation, present amounts, depreciation, additions and betterments, are so separated that the work will not have to be done over again to arrive at any type of valuation at any time in the future, whether for taxation, bond issues, rate making or what not.

The Government valuation force is also getting up a set of forms. These will likely become standard in the course of years when they learn their lesson and find out what they want. An attempt was made by the Interstate Commerce Commission to enforce a certain standard of sheet maps, 20 inches by 56 inches in size, one for station maps, one for right-of-way maps, and one for profiles. Samples were sent to the railroads with the request that they take these as standard, and prepare a complete set of their maps to correspond. But when presented to the country at large many omissions and conflicts were found in these standards and they were afterward withdrawn. The Commission evidently found that it takes a committee of broad experience to get up a standard that will suit conditions of real estate boundaries, track and building construction from Cape Cod to the Golden Gate. Their station plat carried a decidedly eastern air to it, as was shown by the street names, which were mostly those of Charleston, S. C., and by the lack of discrimination in the dot and dash of boundary lines, to make them applicable to township, range, section, half and sixteenth section lines of a sectionized country.

VALUATING RIGHT OF WAY.

To set a value on the right of way as real estate is one of the most difficult parts of the work, as it presents nothing tangible, has no index to itself, and but slight chance of arriving at it by mere measuring and figuring, and applying a unit rule.

Present value if sold.

The price it cost at the time it was purchased.

The price it would cost if purchased now.

None of these as basis for valuation can be applied rigidly, but this information should appear in separate columns to get as much history of the tract as possible, and also there should be columns for overhead charges in buying right of way, clearing title, value of buildings that were on it and the cost of removing buildings.

In some cases railroads have depreciated adjoining property, and have as often made the property more valuable. The price it would cost if the railroad did not exist, but that the town had grown normally without the railroad, seems to be a fair average; that would increase the cost over and above what it was 20, 30 or 40 years ago, yet not expose it to the fluctuation caused by the proximity of the railroad. But the valuator must look into the history of the various transactions, and take into consideration some conditions that actually existed at the time of the purchase. To not do so would be unfair to the capital invested. For instance, the new line of the C., R. I. & P. in Joliet necessitated the tearing down of a hotel worth $100,000. The appraiser might not know this, yet it is a part of the cost of the railroad.

Once away from the towns and the terminals and into the open country the work of valuating becomes much more certain, and the sale value of the adjoining farms may be said to govern, having due caution, however, in regard to some inflated value of fruit lands, and "sunshine" tracts, temporarily high priced for climatic reasons and the gullibility of the would-be fruit raiser.

Before parting from the subject it is earnestly hoped that some instructions will soon be forthcoming from the Interstate Commerce Commission and the Railroad Presidents' Association.

VALUATING ROLLING STOCK.

This should be handled by the mechanical department, and some very good forms have been prepared for this purpose. They should be wide enough in scope to allow for the presentation of the actual cost of a piece of rolling stock to the company. The list price, the amount that was paid for it is all well enough, but arrangements should be made to include the cost of design and delivery. Some of these items may be properly charged to operating expenses, but there should be a clear-cut line drawn at what it is worth when ready to use. There is always an expense for design, an expense for delivery, and an expense for breaking in a new piece of rolling stock that adds to its cost before it is ready to use for operation.

PROCESS OF VALUATING YARDS.

The danger of omission in a yard valuation is great, even with an up-to-date yard map. To get the frogs, switches, etc., the best way is to consider the whole yard as laid off in 100x100 foot squares, and use a latitude and departure system. Then every piece of material will have its number by westing and northing. In this way the danger of omission and duplication is reduced to a minimum. The system was first devised by H. R. Barnes in the field work for valuing the C., M. & St. P. yards around Chicago. The system can be used even in yards that are on a curve. The boundaries on one side of the blocks can conform to the curve line, and the other side to the radii of the curve, taking the farthest out track as the 100-foot chord measure, but in numbering the squares and designating material by latitude and departure, you must consider the yard as being on a tangent. The transit party should number everything as so much north and so much west, using a good yellow crayon, and then another party of two men follow, afterward noting in tabulated field books the kind, weight, size and amount of material.

VALUATING THE DEVELOPMENT COST.

This is another one of the intensely argued points. In the first place the term is a wide one, and heretofore has often been used to cover a multitude of sins, if not actual fraud. To give the term an interpretation, development cost means advertising, subsidizing industries, encouraging settlers and farmers, building experimental tracks to doubtful localities; in fact, doing things that will build up the country and make traffic; and last, but most important, it means that cash which is necessary to expend before the line becomes a paying proposition—the money over and above the cost of construction.

After a road is built it generally takes several years before there are enough industries along its line to produce sufficient tonnage to make the road pay. In the meantime it has to be operated probably at a loss, and this together with the money it takes to pay the interest on its indebtedness is the development cost.

Many of our trunk line roads were built into uninhabited regions, and it took years before settlers, their crops and industries, produced sufficient tonnage to make the road pay. The probability of these conditions was early recognized so that the Government subsidized some roads with large grants of land, with the inten-

tion that the sale of these lands would help tide them over the development period. While in the main the most of this land grant domain has fallen into the hands of the settlers it was intended for, yet large portions of it saw many ownerships and much fraud before it passed under the plow of the bona fide traffic producer. Transfers of large blocks of it went to subsidiary companies, and valuable town sites were deeded to a favored few, so that the choicest income went elsewhere than to pay development expenses.

But the fact is that there has been and is yet such a thing as a legitimate development expense. With almost every industry there is a period between the time when manufacture begins and when sales become profitable. This is recognized by all promoters and good business managers, and funds to tide this period over have to be provided. A creamery has to await the time when the neighboring farms will have enough cows to provide sufficient milk; a shoe factory has to await the time when its traveling salesmen have established enough trade and can get enough orders to make the sales sufficiently large to be profitable. The question now is, is this money part of the cost of the road, part of the capital account, or should it be charged to operating expenses. This is one case where a rigid physical valuation may not represent the requirements in giving proper measure of the worth of the property. In nearly every other business transaction it is recognizeu as part of the value of an institution, something that has cost money and something that has a real asset. Take for instance a hotel that might have been running three years before a sufficient number of the traveling public came nightly to fill its rooms. The expense of operation was going on all that time, and if the business was transferred, the money it invested during that period in getting its start, would be recognized and capitalized as part of the assets of the plant. Now a great many of our railroads are owners of hotel systems. If some of these buildings were put on the market as so much lumber, stone and labor, they would be jumped at as great bargains, while some others might not bring the price of firewood, and it is soon going to be a question in some men's minds as to how much they are worth. The safest way, of course, is to adhere rigidly to the cost of reproduction. But if this is done throughout, the railways will stand alone in the business world as freaks who spend money for nothing.

There are some classes of development expenses that may be inventoried and priced as measurable quantities, and, divested of any appearance of fraud, are truly a benefit to the railway and the community. Many are the cases where a road has through the action of its board of directors made large investments in the stock of new industries, knowing full well that these industries would go into the hands of a receiver, and the money lost so far as the road was directly concerned, but they had the foresight to know that they would eventually pay out and become good tonnage producers.

Among this class, which the roads helped along, may be mentioned dams, sawmills, irrigation ditches that have served their time, mines that failed to pay, toll roads, industrial expositions and experiment farms. The original cash value can still be determined for a number of these, and where such is the case and no fraud appears they should be part of the cost of the road, and taking them altogether, they make quite a portion of the expense of the development of the country until the road was on a paying basis.

One of the strong arguments against allowing any development cost is that many of our railways were built as promotion schemes and from start to finish never had any chance to pay out or get out of the development period, and were never expected to be anywhere else, and it was known by their promoters that failure and absorption would mark their end. Many and powerful are some of these arguments, but as a matter of fact such a cost does exist, especially measurable in the case of interest paid on the money used, and the engineer who ignores it will place himself within the scope of that metaphor, "Figures do not lie, but liars use figures." And many of these strong arguments come from the very cream of the engineering profession, and taking this as the measure of their common sense it is not strange that so many of them make failures when they branch out as business managers or contractors, and separate themselves from a pay-roll kept alive by broader minds. And we also have a court's decision on this development cost covered by the following words: "The value of that which it employs for the public convenience," Smith vs. Ames, 169 U. S. 522, and while we may have to get another court's interpretation on this court's decision, it is safe for the present to maintain that if this money was used for the proper development, and to maintain and run this road for the public convenience, it is part of the cost of that enterprise, however fallacious its inception and location might be.

ITEMS OF APPRECIATION.

Some items of a railway grow better with age, and this is called appreciation or an increase in value over and above their original cost. What this increase is theoretically worth has been tabulated for some roads and some states, but whether suitable for other systems and localities is unsafe to say. Certain it is, though, that a cut or a fill that has developed a good growth of sod on the slopes is worth more than a fresh made one. This is also true of more solid fills and better drained cuts, and of some forms of river and harbor protection; they are much better now than when first made. The present ballast on a roadbed that can be seen and measured is perhaps but a small part of what has been sunk in there, of the many coats that have gone before and helped to make the track as stable as it is. Snow fences and sand dune protection come in the same class, as it probably required many moves to find their best location, all of which took money and is part of the cost of the road, and makes them worth more, over and above their measured value. There may be some brilliant arguments against this, but the proper measure is the facts. However great care should be taken not to confuse with these what is properly a maintenance charge.

SOME ITEMS OVERLOOKED.

The cost of inception and promotion, often the life-work and financial ruin of some hopeful individual, should not be overlooked. While some projects, by weight of necessity, have boosted themselves, the great majority of them were one-time nurslings of some few men who had faith in their own visions. Right big men there have been, and right small men there have been, from J. Cook, the banker, down to the penniless fur trader, who have sacrificed their means to support initial development of transportation projects; and trips into the interior, trips to Washington, trips to Europe to raise money, costs of maps and publications, charters, expert lawyers' fees, expert engineers' fees, and preliminary surveys have all been paid for part in grief and part in money. There is no way of measuring it, but wherever an item of the kind is come across, and can be properly identified, it should be tabulated in the proper sheet and column to be credited to the cost.

The payment of bonuses for money, if not so exorbitant as to be criminal, is as legitimate a cost item as any other commission or fee, for the brains that know where the money is to build the project are worth as much as the brains that know where the road should go.

The cost of advertising and the solicitation of loans.

The cost of winter work where large forces of men were used shoveling snow to keep the trails open.

There is no possibility of listing all these items, but when they appear as one of the necessary steps to construction they should be given credit in columns allotted for the purpose. In this respect and particularly in regard to items that might be called in question by others, never submerge anything by addition with anything else, but leave it so it can be taken or rejected; use more columns; use more paper, and leave the record clear, so that others can understand it and add it up to suit a condition or a court decision that might arise.

ENGINEERING AND SUPERINTENDENCE.

For a long time it has been customary at the tail end of a statement of cost to throw in 10 per cent for engineering and

superintendence, and it seems strange that this is done when all the other details are gone into so carefully. Perhaps it is but another instance of the old saying, "shoemakers' children always go barefooted," that the engineer after counting every bolt and rivet, every tie and rail fastening, and so carefully analyzing the various branches of the work, is incapable of placing any other estimate than 10 per cent on his own services. More often than not the office records show how many preliminary surveys, how many location surveys were made, and how many resident engineers were used on the line, and even if they do not, he should be a very good judge of the personnel and expense he would use if in charge himself, and he should not forget the tie and timber inspectors, the steel and other material inspectors, who are on the pay-roll but not in evidence on the job. The various items of a railroad's cost are each in themselves but small percents of the whole, and if handled as carelessly as the engineer does his own services, the valuation would be nothing but a bare-faced guess. This matter has already been brought in question by administrative heads of many railway commissions who are not engineers and who do not appreciate our idiosyncrasies in playing Hottentot with our own figures, and thus imitating those natives of Africa whose mathematical abilities are limited to the count of the fingers on the two hands—namely 10. Engineering and superintendence might be more and might be less than 10 per cent, but it should be ascertained to a certainty, or estimated as near as possible; not lumped in.

A PARTIAL LIST OF PUBLICATIONS ON PHYSICAL VALUATION.

The American Society of Civil Engineers has issued a list of 398 books, pamphlets and periodicals on the subject of valuation exclusive of street railways. The U. S. Government (Library of Congress) has issued a list of 119 works, mostly public documents, and regular firms of scientific book publishers have large lists. So there is ample material available for those who wish to inform themselves. But most of these writings are from the talkers; the doers are not very much in evidence. It is criticism in advance of the real work; instructions how to do it are very much lacking. There are too many of them written with a feeling of unrest, a fear that valuation is wrong, and with an idea to protecting interests that pay fees and salaries; that something will be done which had better be left undone; that somebody is going to make a mess of something. And in a number of ways these fears are well founded. Something is going to happen. The railways will have to come up to date, abreast of other business institutions, and know the value of their plant, and the 10 per cent engineers will have to change their ways and learn to look as carefully on their own labors as they do on the work of others. Hundreds of engineers know the business already; many more hundreds will have it to learn. The best schooling is to be actually in the work on several hundred miles of line, and those who know it the best are those who do it the most—the U. S. Civil Service Commission to the contrary notwithstanding.

INFORMATION DESIRED FOR FEDERAL VALUATION.

George W. Kittridge, chief engineer of the New York Central & Hudson River and supervision valuation engineer of all the New York Central lines, has produced a public circular asking for information desired to fulfill all the requirements of the act pertaining to the physical valuation of the railways.

This circular is original in this connection and has elicited replies from the most unexpected sources concerning the early construction and development of the railways of this company, of which there was absolutely no official record. Some of these replies have told of early wrecks at drawbridges, when locomotives have been lost and never recovered, of the difficulties encountered in holding old fills and cuts, of old trestles over marshy ground that have long since been filled, of houses torn down in towns and villages that are now thriving cities, and numerous other important data of which there is no existing record in present day files. This circular teaches us two things—first, the fallacy of the wording of the bill authorizing the physical valuation of the common carriers, and secondly the thoroughness with which some of the railway companies are adapting themselves to fulfilling the requirements of this act. The circular in detail is as follows:

A valuation of the New York Central Lines may be undertaken soon in accordance with the Act of Congress approved March 1, 1913, for Federal Railway Valuation.

All the property and elements of cost of construction and early development must be noted and duly considered in order that justice be done to all interested parties.

Parties or individuals will go over the roads to measure the right-of-way, grading, tracks, structures, etc., and make notes thereof, and examine the office records.

There are many items of property and other elements of cost that they may overlook, because they will not be visible or known.

The object of this circular is to bring out information relative to these matters which might be overlooked, and as to the existence of old plans and records in which such information may be contained.

A list of some of the items in regard to which information is especially desired is shown below. Anyone having any knowledge of these or similar items is hereby requested to send the information promptly to the chief engineer of the railroad company to which such information applies (whose address can be obtained from the nearest company agent) or to the undersigned. In sending state the location and give a description of each item.

In addition to personal information, the names and addresses of old employees and others who may have a knowledge of the original construction of the roads, and of early extensions, improvements and development of them, are much desired.

It is also desired that information regarding the property of the railroad company be freely furnished to the railroad employees engaged on valuation work.

PARTIAL LIST OF ITEMS ABOUT WHICH INFORMATION IS DESIRED.

1. Note books, maps, profiles, plans and other records of construction, especially the older construction, not filed in the general offices.
2. Special construction under road-bed embankments through swamps and marshy ground, such as log and brush mattresses, corduroy, etc., and filled trestles.
3. Subdrains in cuts and elsewhere which would likely be overlooked.
4. Embankments that have sunk below the original surface in construction or under traffic, requiring excess filling.
5. Embankments that have slid away into rivers or otherwise out of place.
6. Slides, washouts, fires, wrecks, injuries to persons, equipment lost or damaged, calamities, etc., during construction.
7. Hills that have been entirely removed, or hollows that have been filled, either in connection with the roadbed or station grounds and yards.
8. Unusually difficult materials encountered in grading not now evident, including frozen material excavated.
9. Cuts originally wet but afterwards dried out.
10. Cuts in rock where the rock does not show now.
11. Borrow pits, not easily discoverable, from which material has been taken for roadbed or ballast.
12. Clearing and grubbing originally done that might be overlooked on account of the adjacent land now being cleared.
13. Special construction for roadbed protection, such as piling, cribs, mattresses, rip rap, sea walls, retaining walls, etc., not now visible or easily discoverable.
14. Changes in highways and roads.
15. Changes in channels of streams and canals to reduce the number of bridges, to prevent overflow, to make room for roadbed, etc., and dredging in channels.
16. Temporary tracks, trestles, etc., on account of highway or channel diversions or to take care of traffic during construction.
17. Buildings, bridges or other structures moved or torn down during construction.
18. Difficulties and unusual conditions experienced in the construction of tunnels.

19. Dikes, rip rap, dams and other work on streams for the protection of bridges, which might be overlooked.
20. Enlargement of Government or other levees.
21. Difficulties and unusual conditions experienced in the construction of old bridges, culverts and buildings, especially in the foundations for the same, as in case of striking quicksand, etc.
22. Foundations of old structures which are of unusual depth or size or contain piles or other forms of construction which would not ordinarily be suspected.
23. Rip rap around piers and abutments which is not ordinarily visible.
24. Culverts, drains, conduits, sewers, water pipes, etc., which are not readily discoverable, and especially those built by the company which are outside the right of way.
25. Construction of cattle passes, bridges and other structures and grading and other improvements off the right of way in connection with acquiring right of way or otherwise.
26. Payments by the railroad company for the privilege of closing private crossings.
27. Curbing and paving of streets, construction of sidewalks, water lines and sewers in towns and cities done or paid for by the railroad company and other special assessments against the railroad company.
28. Unusual difficulties in connection with the development of water stations and water supply.
29. New lines or structures begun and not completed.
30. Temporary leases of property in connection with construction.

Information should be sent by letter as above requested.

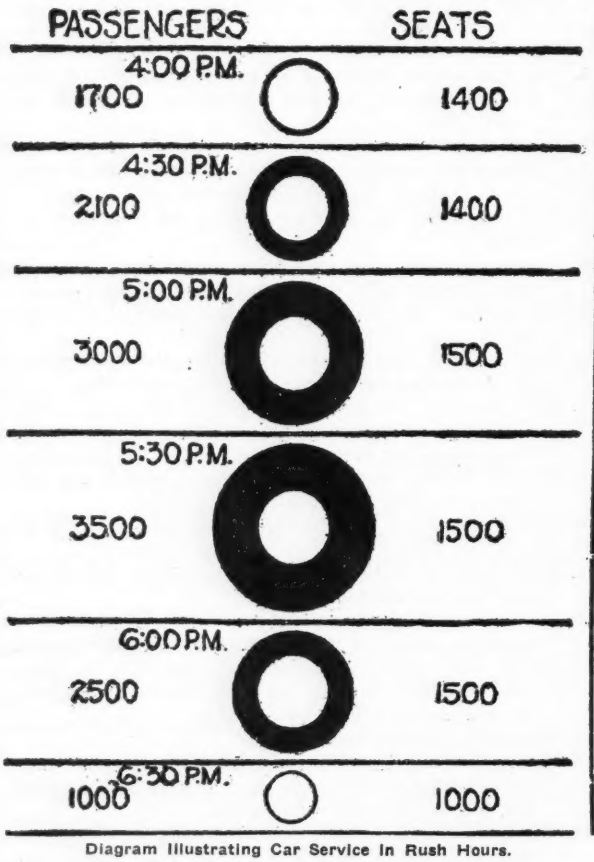


Diagram Illustrating Car Service in Rush Hours.

CAR SERVICE IN RUSH HOURS ON A TRACTION LINE.

The Public Service Commissioner of the city of Chicago, Montague Ferry, has published a most interesting chart which shows the seating capacity of one of the characteristic lines of the traction company in Chicago. This chart is a diagrammatic illustration of the inadequacy of the traction company to properly handle the amount of traffic. But it does not demonstrate whether this is caused by insufficient equipment, faulty schedule, undue congestion at certain points, or whether the limit capacity of the tracks has been reached. All of these questions, in addition to many others, ought to be diagrammatically shown at the same time in order to demonstrate both sides of the matter and show where the most efficient remedy can be applied the quickest. This the commissioner will undoubtedly do as the investigation develops.

The illustration depicts the "Traffic Chart of the Madison Street Line, City of Chicago," and is devised from the basis of a three days' average observation. The circular white area indicates the relative number of seats. The black ring shows passengers for which no seats were provided. The entire area represents the total passengers riding in each half hour.

BRONZE STATUE: C. & N. W. R. R.

A bronze reproduction of the queerest, clumsiest, funniest little old railroad car in the world has been hung in the train concourse of the new Chicago and Northwestern railroad terminal. The original was built in 1864, and was the first railway postal car in the country.

George B. Armstrong's name appears below the reproduction of the car, because it was his idea that brought the railway mail service into existence. The Chicago and Northwestern railroad had the reproduction made because it was the first source of encouragement to the persistent inventor. The railroad furnished the financial backing, and on August 28, 1864, the first mail was carried between Chicago and Clinton, Iowa. It was the knell of the stage coach. By 1867 two more mail cars had been built and put into service between Chicago and Fort Howard, Wis., and between Boone and Council Bluffs, Iowa.—*Chicago Tribune.*

THE OUTLOOK IN CANADA.

SIR DONALD MANN.

Sir Donald Mann, vice-president of the Canadian Northern Railway, expressed the opinion in an interview that the amount of capital available for Canadian railway and other development will not be lessened by the enormous waste of the present military conflict. Sir Donald's cheering outlook is based upon his expectation that the Allies will not permit the war to end until some permanent solution is in sight, the only solution being a partial or entire disarmament.

"I see no reason to believe that the flow of capital toward Canadian development of all kinds will be seriously affected," he observed. "Matters are so shaping in Europe that the nations are more than likely to end their quarrel by a treaty based on mutual disarmament. There would seem to be no other way out of it. Should that come about, should the powers agree to cease their rivalry in fighting equipment, the cost of this war, great as it is, could be borne without complaint. The annual saving in the military and naval budget would quickly wipe out the indebtedness now being heaped up in millions. This would leave capital free to seek the best market and Canada would continue to attract investment."

Sir Donald made the interesting prediction that the new ocean-to-ocean line of the Canadian Northern will be put into action next summer whether the war continues or ceases. There was no good reason, he said, why delay should be permitted. The last yard of trackage will be finished in January, it is expected, at a point in British Columbia, where large forces are now working. The weather conditions will prevent further ballasting until spring when this final process will be rushed to completion.

Settlement of vacant farm lands will be vigorously revived after the war, said Sir Donald. Just at present settlement by new arrivals has practically ceased except for a small number of Americans.

CONCRETE DEPARTMENT

Reinforced Concrete Floors for Steel Bridges

THE merits of the reinforced concrete floor for steel bridges as compared with the old type of open wooden floor are so well known that no further comment upon them is necessary. The popularity of this type of bridge floor is witnessed by its ever increasing use on nearly all of the larger roads of the country. According to the recent report of the committee on Reinforced Concrete of the American Railway Bridge and Building Association, one road, the C. M. & St. P. Ry., has over 7 miles of single track concrete slab floors for deck girder spans in use. This fact is indeed noteworthy when one considers that only about eight years ago no such floors were in use.

Now that reinforced concrete bridge floors have become standard on a large number of roads more attention is naturally given to details of construction, such as the location of construction joints, expansion and contraction joints, and the covering and waterproofing of these joints, as the case may require. Difficulties encountered with some of the first floors where proper attention was not given to these and other details have given rise to the use of many ingenious methods and devices for remedying the difficulties.

In some cases considerable trouble was experienced from ballast working into construction and expansion joints which, when the slabs expanded, caused a chipping and cracking of the slabs of a dangerous character. Various schemes for preventing this trouble have been used with varying success. One of the simplest of these details for covering the longitudinal joint between slabs for a double track bridge is that used by the B. R. & P. Ry., and illustrated in an article on the standard concrete floors of this road, appearing on another page in this issue. The stem of a small T-iron is inserted in the joint and the flange covers the entire joint.

The methods of construction of these slabs are quite different even on the larger roads, some building the slabs in small units in central yards and then transporting them to the site, while others have standardized formwork so as to allow of the economical construction of slabs in place. Just as to which practice is the best and most economical is an open question and no doubt will be for some time to come, the general conditions on different roads being the deciding factor.

"*Concrete for Permanence*"

CONCRETE has revolutioned the art of building and every day more advocates of its use enter the field and thereby spread its fame to all parts of the earth. As with all industries enjoying a rapid growth, more or less poor concrete has been put in structures by unscrupulous men in an effort to get "rich quick." Such concrete, usually containing very little cement, *is not permanent* and does the industry an injury, the effects of which cannot always be measured. What we need is a campaign for better concrete, that is concrete in which sufficient cement is used to properly fill up the voids in the aggregate, then many of the troubles often confronting us (due to poor concrete) will disappear.

Many of the men in the concrete field have taken up a slogan to promote the concrete industry, which is an excellent one; viz., "*Concrete for Permanence.*" In this slogan the word *good* is implied as a prefix and it would have perhaps been a good idea to actually use the word in that connection until the industry had reached such a stage that when the word *concrete* was mentioned the idea at once conferred, would be "*good concrete.*"

"*Good Concrete for Permanence*" should be the watchword of every engineer, contractor, superintendent, foreman, and so on down to the wheelers of aggregate. The man in charge should make it his duty to impress upon his men the necessity of care and co-operation in producing good concrete and the benefits will soon become apparent.

A slogan generally is the means of cementing together the various elements in the field, and the end is attained sooner than if each unit struggles along in its own way toward the goal. Therefore, let us all unite for the benefit of the whole concrete business and use the slogan wherever and whenever consistent.

Mixing and Placing Concrete by Means of Compressed Air

IN THE past few years a great variety of mixing and distributing plants have been used on various concrete jobs, always with the idea in mind to economize on the cost of concreting as much as possible. Some of these plants have only been suitable for use of the particular job for which they were designed, while others have been far more flexible and adaptable to widely different construction layouts.

On another page in this issue appears a description of a machine and the operation thereof, which mixes and places concrete by means of compressed air, the two operations taking place simultaneously. This represents one of the most compact plants which has yet been devised for this work, and it is very significant that it is made possible by the use of compressed air, which has revolutionized practice in several industries or branches of industries by such inventions as the air brake, pneumatic riveter, rock drill, sand blast, air lift, diving bell, and pneumatic caissons.

The natural question to ask regarding this machine is whether concrete mixed and placed by air is as good as concrete mixed in an ordinary mixer and placed by other methods. The work on the Arminto tunnel demonstrates that the concrete mixed and placed by air is very dense and of excellent quality. The same has been true of work done by similar machines on other types of concrete structures. This fact, coupled with the low cost of operation, is sure to make this method of concreting very popular.

The New York Telephone Co. now makes and uses on its lines hollow reinforced concrete poles. Double ended eye bolts are cast in the poles for fastening guys and holes are provided for the attachment of cross arms. The hollow poles are being used since this construction gives a maximum of strength with a minimum of cross-sectional area and cost. The poles are conveyed to place in field either by pole buggies or for short hauls over common timber horses with roller tops.

Reinforced Concrete Floors for Steel Bridges, Buffalo, Rochester & Pittsburgh Railway

DETAILS OF DESIGN AND CONSTRUCTION OF SEVERAL STANDARD TYPES OF SOLID FLOORS FOR PLATE GIRDER AND TRUSS SPANS.

By A. M. Wolf, C. E.

The Buffalo, Rochester & Pittsburgh Ry. has adopted as standard, five types of reinforced concrete floors for steel bridges, three different types for through plate girder spans, one for deck girder spans and one for through truss spans. These floors are being installed on practically all new steel bridges and in order to build these floors under traffic, where necessary, some interesting details for supporting forms and tracks have been evolved. In view of the increasing use of concrete bridge floors the unusually complete details here given are of exceptional value to the bridge engineer.

Designing Loads and Unit Stresses.

All bridge floors are designed for the dead load of slab, ballast and track and Cooper's E-60 live load with impact in accordance with the following formula:

Concrete of a 1:2:4 mixture with ¾-inch broken stone as the coarse aggregate is used in all cases. The designing unit stresses top of floor beams. The forms consist of 2-inch planks carried on 2-inch planks set on edge between steel beams.

The slab is carried out over the backwall of abutments on a zinc plate extending over the full width of horizontal and vertical joints between backwall and deck slab. This effectually provides for free movement of slab due to expansion and contraction.

Drainage nipples 2 inches in diameter are placed 7 feet 6 inches centers along center line of track, to carry away drainage. Where bridges cross highways a 5-inch galvanized ingot iron gutter with downspouts at abutments catches the drippings from drainage nipples.

Waterproofing.—After the concrete surface has been prepared by leveling up all uneven places with 1:2 cement mortar and after the concrete has dried out and thoroughly set a membrane waterproofing is applied.

The concrete surface is coated with a heavy coating of hot asphalt (not exceding 450 deg. F.) and while still hot two layers of asphalt saturated felt (weighing not less than 14 lbs. per sq. ft.) and a top layer of asphalt saturated burlap (containing 13 lbs. of asphalt and weighing 19 lbs. per sq. ft. after

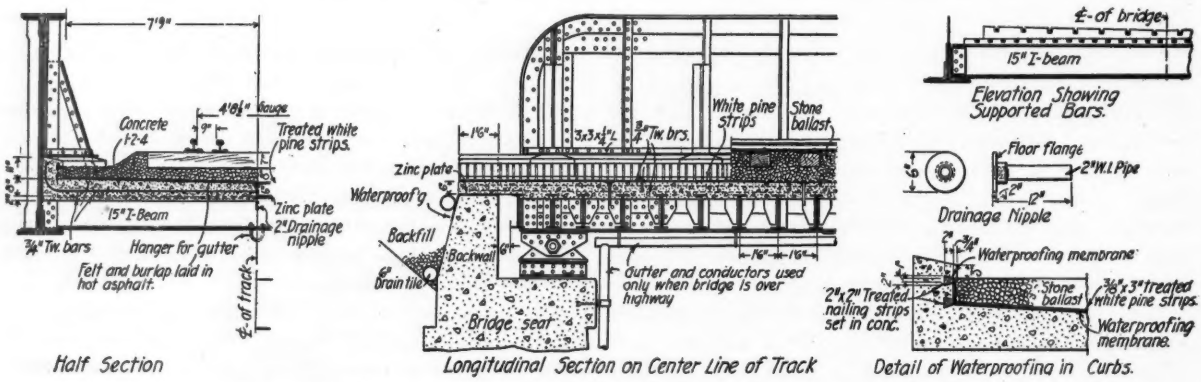


Fig. 1. Type "A" Reinforced Concrete Floor for Through Plate Girder Spans, B. R. & P. Ry.

are: Concrete in cross bending compression, 500 pounds per square inch; and steel in tension, 16,000 pounds per square inch.

Type "A" Floor for Through Plate Girders.

A common type of solid floor, known as *Type A*, is used for through plate girder spans with transverse I-beams at comparatively close spacing, carrying the floor slab on their top flanges. This floor, shown in detail in Figure 1, is 6 inches thick over tops of I-beams at centerline of track and 8 inches above I-beams at the curbs formed at the sides, thus providing for drainage. The bottom of the slab is set 2 inches below the top of floorbeams. The total thickness of this floor system from bottom of I-beams to base of rail is 3 feet, a depth of 8 inches of ballast being used under ties.

These slabs are reinforced with ¾-inch square twisted bars at 6-inch spacing in bottom portion of slab 1 inch above top of beams and transverse to same, with ¾-inch bars at 1 foot spacing 1 inch clear below top of slab. Distributing bars are placed on the lower layer of bars midway between I-beams and parallel thereto at 18-inch spacing. These distributing bars are bent up into the curbs at girders, which are 9 inches high at the face and 11 inches high at the web of girder under protection angle, with the face projecting 2 inches beyond edge of stiffener angles. The curbs are reinforced with three ½-inch bars continuous in top and side. The main reinforcing bars are held in place during concreting operations by means of notched boards resting on the saturation) are embedded in the asphalt. The felt and burlap are laid parallel with longitudinal centerline of bridge, beginning at the center, with each layer overlapping at least 10 inches, shingling and mopping in same with hot asphalt so as to separate each layer with a coat of asphalt. The several layers lap past the longitudinal centerline of bridge at the drainage line at least 10 inches and are closely worked around drainage nipples. The felt and burlap are carried up to the underside of the ¾-inch projection on side of concrete curb and fastened to treated wooden nailing strips embedded in the concrete.

A heavy coat of asphalt is then applied to the burlap in which treated white pine strips ⅜ inch thick are embedded as a protection for waterproofing. These strips are laid transverse with bridge and with a ¼-inch space between them and a 2-inch space between the ends of abutting strips along centerline of bridge to provide an adequate gutter for water. After the strips are placed the asphalt is poured level with tops, and after hardening the ballast is put in place. The above method of waterproofing is used for all types of floors hereinafter described except Type B, for which a special method is used.

Type "B" Floor for Through Plate Girders.

The Type "B" floor (Fig. 2) for through plate girder spans consists of a concrete slab carried on the bottom flange of transverse I-beams at 2-foot spacing, with the upper portion of beams entirely encased in concrete, thus forming a series of transverse

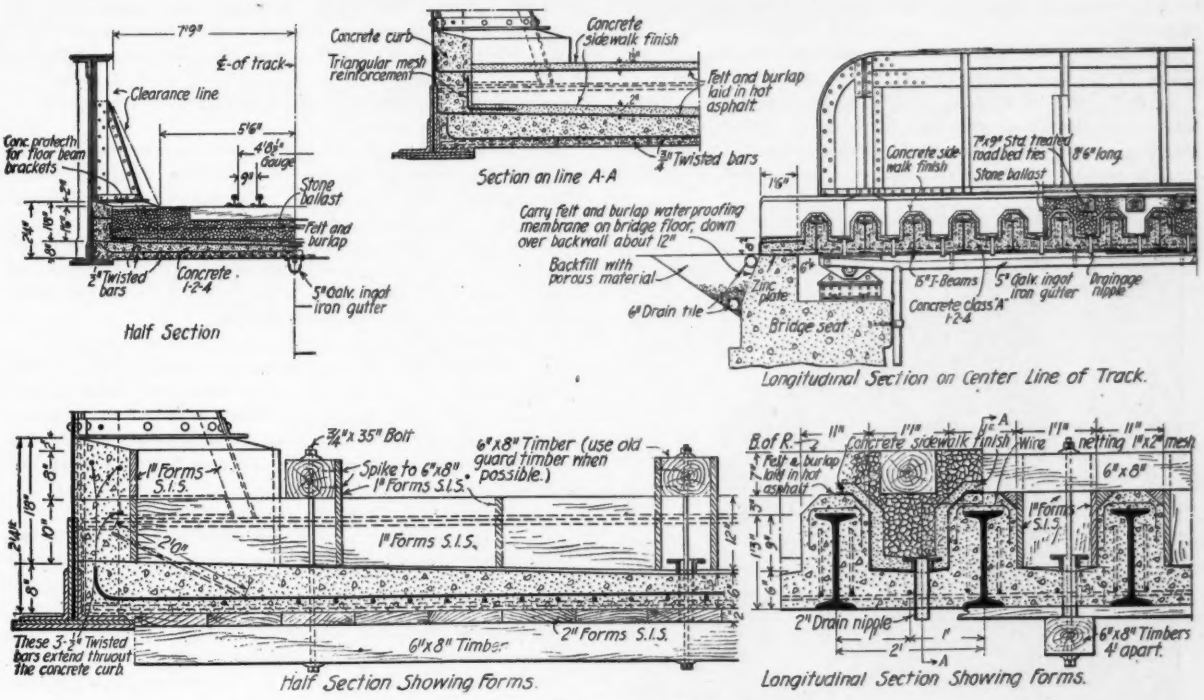


Fig. 2. Type "B" Floor for Through Plate Girder Bridges.

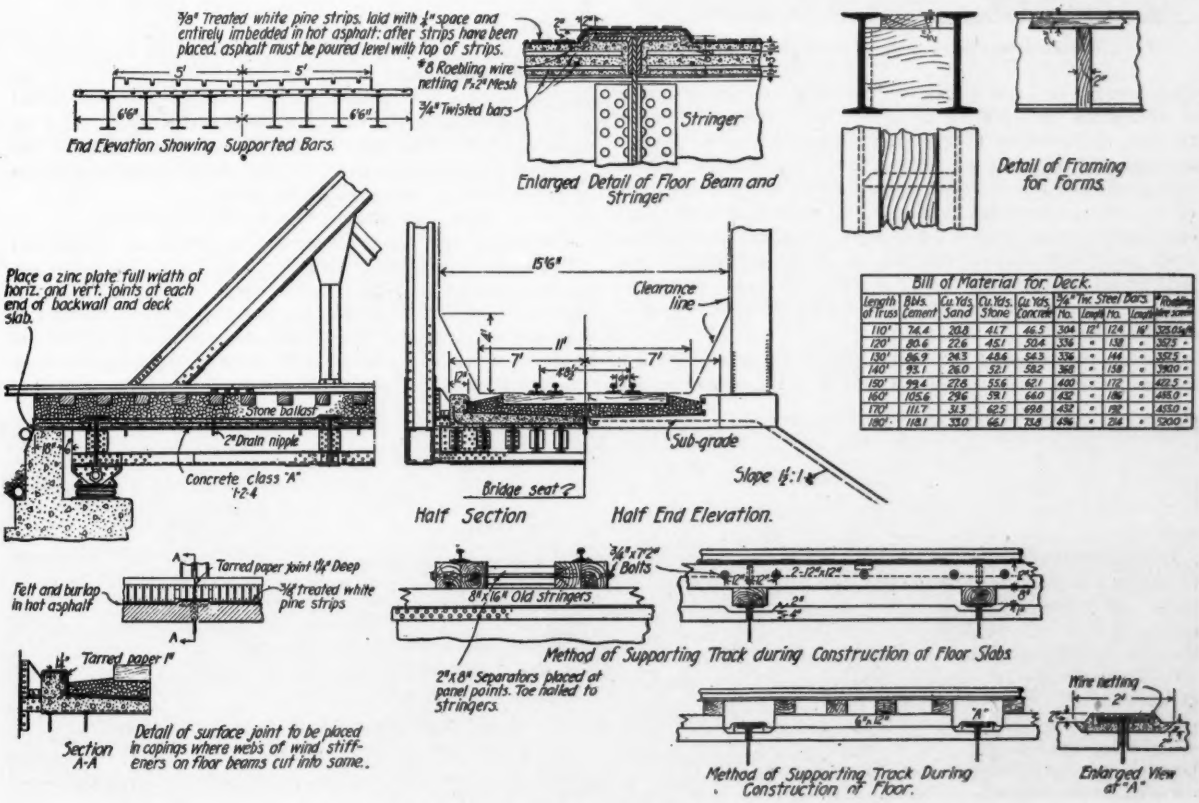


Fig. 3. Type "C" Floor for Through Stress Spans.

troughs, which are filled with ballast, the ties being laid at these points.

The slab between floorbeams has a minimum thickness of 5½ inches at the centerline of track and a maximum thickness of 8 inches at the curb built against the girder, the difference being taken up in the top slope to care for drainage through nipples in each trough. The troughs are also given a pitch of ½-inch from sides to center. The main slab reinforcement consists of ½-inch

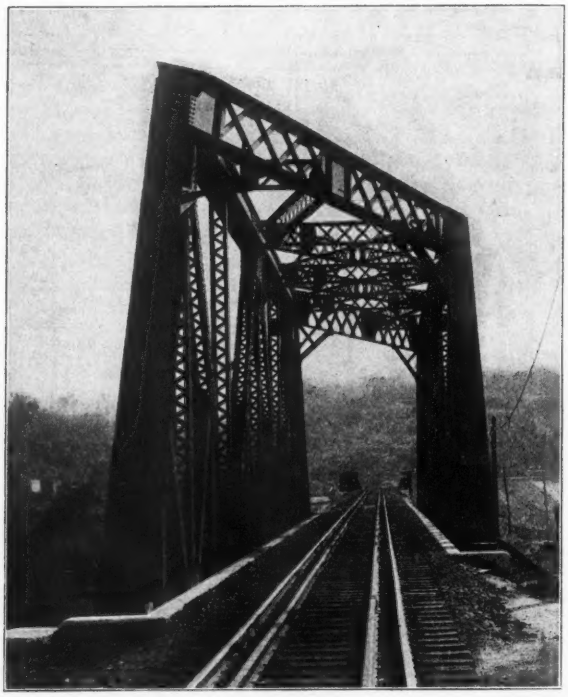


Fig. 4. Truss-Bridge with Type C Floor, B. R. & P. Ry.

square twisted bars at 6-inch centers for 5 feet 3 inches either side of center, the bars passing through holes in webs of I-beams 1¾ inch above bottom of the latter. Transverse to these main bars are ½-inch bars, one midway between floorbeams with a hook at the end and one close to the I-beams at either side bent up at each end as shown in Fig. 2. In order to keep the concrete intact over the tops of I-beams No. 8 Roebling wire netting, 1"x2" mesh is bent down over the top flange as shown in the longitudinal section (Fig. 2). The slab is carried out over backwall and separated from same by a zinc plate to insure a positive expansion joint.

The concrete encasing the steel beams is 11 inches wide and extends 3 inches above the tops of same with the corners beveled off at 45 degrees. The bottom forms of 2-inch planks, dressed one side, are held in place by 6x8-inch timbers transversely 4-foot centers, hung by means of bolts from three longitudinal 6x8-inch timbers one at center and one at each side, blocked up on the floorbeams at several points. The side forms for encasement of beams are of 1-inch material.

After the concrete deck is completed and the concrete has dried out a membrane waterproofing is applied as described under "Type A," the same being carried up on webs of girder as shown in large scale cross section, Fig. 2. The reinforced concrete curbs 1 foot 8 inches high and projecting 2 inches beyond stiffener angles are then placed over the membrane. After the curbs are placed a layer of sidewalk finish is put on, as shown in the detail sections (Fig. 2), to protect the membrane.

Where the bridges are located at square crossings the ballast is carried up 5½ inches above top of finish of beams, the ties being placed directly over the troughs in the floor. This type gives a relatively shallow floor, viz., 2 feet 1 inch from bottom of beams to base of rail. On skew bridges the track is raised at least 4½ inches to allow 3 inches of ballast between bottom of ties and top of concrete over end floor beams.

Type "C" Floor for Through Truss Spans.

For through truss spans with floorbeams at panel points and I-beam stringers parallel to centerline of track a reinforced floor resting on top of stringers, known as "Type C," is used. (Figures 3 and 4.) The slab is made 6 inches thick at centerline of track and 8 inches at the curbs, which are 1 foot thick and 1 foot high with face 6 feet from center of track. The main reinforcement is placed parallel to stringers and is the same as for the "Type A" floor. At floorbeams the concrete is raised 2 inches to cover the top flange and reinforced with No. 8 Roebling 1x2-in. wire mesh to prevent cracking.

Drainage nipples are placed at 4-feet 6-inch intervals along centerline of track to carry off the drainage. The waterproofing for this type of slab is the same as described under "Type A."

The floor slab is poured on planks between flanges of stringers supported by 2-inch planks set on edge on bottom flanges. If the slab is built under traffic the track is blocked up on the floorbeams with each rail carried on two 12x12-inch wooden stringers between floorbeams. After the slab has cured thoroughly the ties are put in and blocked up on 6x12-inch stringers resting on the slab between floorbeams and the concret protection for the latter is put on. (See Fig. 3.) The ballast is then hauled in, the 6x12-inch temporary stringers removed, and the track raised so as to give 8 inches of ballast under ties at center.

Type "D" Floor for Deck Girder Bridges.

For deck girder spans with transverse I-beams at about 1-foot 6-inch spacing, a type of floor (Type D, Fig. 5) of practically the same design as "Type A," is used. The floor is 6 inches thick at center and 8 inches at the curbs, which are 1 foot 1 inch high and 1 foot thick. The overall width of floor is 14 feet for single track spans. On double track spans the slabs for each track are separated by a ½-inch joint at center line between tracks and

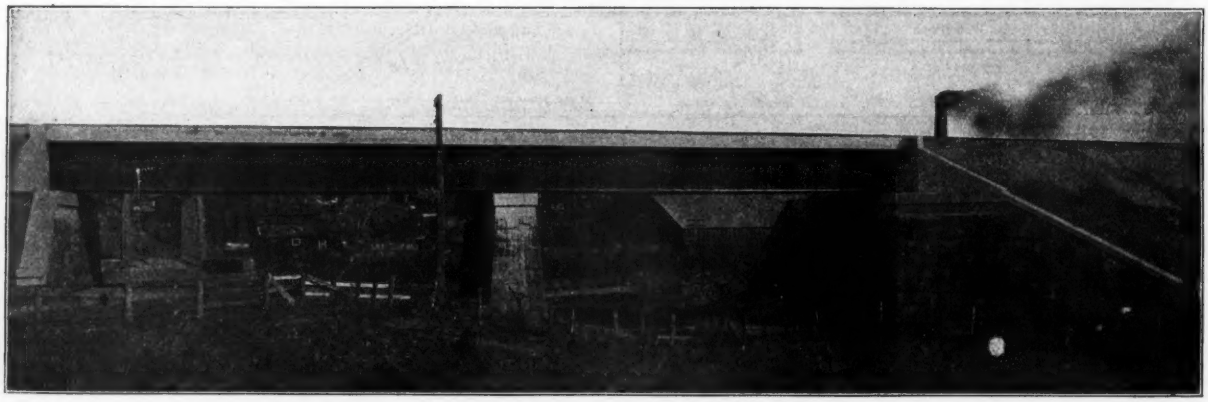


Fig. 6. Deck Girder Spans with Type "D" Reinforced Concrete Floor.

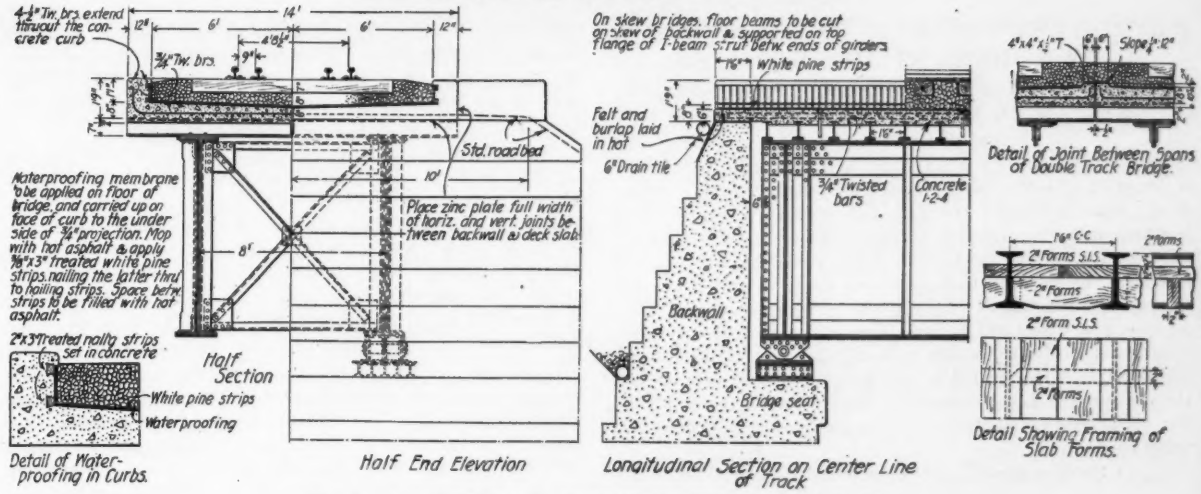


Fig. 5. Type "D" Floor for Deck Girder Bridges, B. R. & P. Ry.

a 2-inch curb 6 inches wide at edge of each slab, each slab being drained independently. To cover the joint between slabs the stem of a continuous 4x4x¼-inch Tee iron is inserted in the joint.

The method of supporting forms and bars during construction, also the method of waterproofing, is the same as for "Type A." A maximum depth of 8 inches of ballast under ties is used at the center of track.

A "Type D" floor is shown in Fig. 6. This illustration shows very clearly how much more finished and stable a solid floor bridge appears than one with an open floor. As a passing comment, this illustration shows how very readily additions can be made to existing masonry structures by using concrete, and in this case, greatly enhancing their appearance.

"Type H" Floor for Through Plate Girder Spans.

Where double track through girder spans without intermediate girders are used, a floor of "Type H," shown in Fig. 7, is used, the floor resting on the top flanges of I-beam stringers framing into transverse built-up floorbeams.

The slab is made 6 inches thick at the centerline of track and 8 inches at the webs and at centerline of bridge. The reinforcement, method of construction and waterproofing is clearly shown in Fig. 7, and is substantially the same as for "Type C" floors.

Comment.

The writer is indebted to Mr. E. F. Robinson, chief engineer, Buffalo, Rochester & Pittsburgh Ry. Co., for plans, photographs and data used in preparing this article.

"CONCRETE FOR PERMANENCE."

Engineers of the Santa Fe Railroad are giving valuable engineering aid to counties and municipalities bordering on their line. The new concrete highway bridge at Salina, Kan., was designed by them.

The Chicago & Illinois Western extension from Forty-sixth avenue (Hawthorn, Ill.) eastward to connect with the Pennsylvania track at Rockwell street and Marshall Boulevard (Chicago, Ill.) is nearing completion. The contract for the last viaduct at Marshall Boulevard has been awarded to the Kelly-Atkinson Construction Co., of Chicago, the steel work being furnished by the Chicago Bridge & Iron Co.

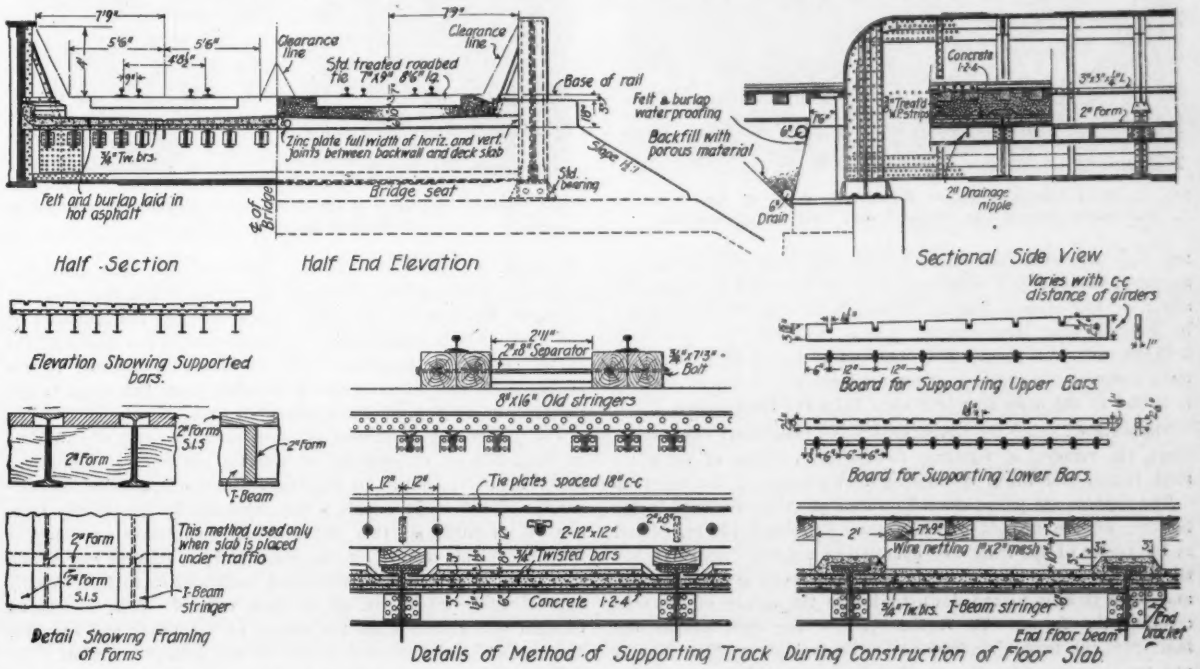


Fig. 7. Type "H" Floor for Double Track Through Plate Girder Spans.

METHOD AND PROGRESS OF LINING C., B. & Q. RY. TUNNEL AT ARMINTO, WYO.

Describing the Use of a Special Concrete Plant Mounted on a Flat Car, for Mixing and Placing Concrete by Means of Compressed Air.

The Chicago, Burlington & Quincy Railroad has in progress the construction of a line connecting Thermopolis and Orin Junction, Wyo. This line being the final link connecting the Colorado Southern with the extension between Billings and the Colorado Southern Ry., passing through Cheyenne to Denver. This line also completes the so-called Gulf to Sound Route of the Burlington System. At the summit of the grade between Casper and Thermopolis, is a tunnel 800 ft. long, excavated a year ago in rather treacherous sandstone, which required timbering throughout its entire length. This tunnel is now being lined with concrete and the timbering is being removed as the concrete lining is put in. The compressed air method of mixing and placing the concrete is being used.

Fig. 1 shows a general view of a portal of the tunnel, which

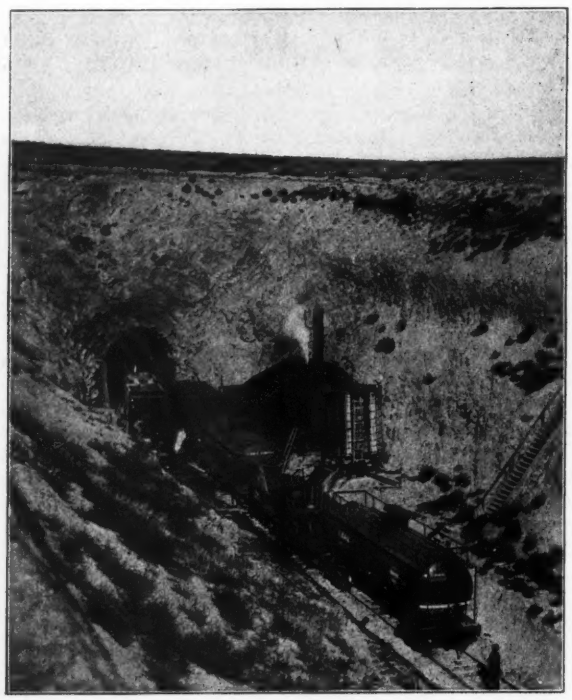


Fig. 1. East Portal, Arminto Tunnel, C. B. & Q. Ry., Showing Automatic Mixing Car, Boiler House and Compressor Car.

has long approach cuts at both ends, the west end having an approach cut nearly a mile long, and the east end having a cut about one-half mile in length. Materials for concrete are brought in gondola cars from Casper, where the sand and gravel is dredged from the river. This material is stored along side the main line near the entrance of the approach cut to tunnel. Cement is stored at the same site in a shed built for the purpose.

The work of lining the tunnel constitutes three main operations: First, the removal of timbers; second, the erection of the Blaw steel forms, and third, the mixing and placing of the concrete.

The timbers are pulled down by means of cables fastened to the bottoms of the uprights, passed through snatch blocks, placed in the center of the track and operated by a dinky engine. When the posts are pulled out the roof falls, the debris is cleared away and loose rock is picked down to insure the safety of the men erecting the forms. To further protect the men, planks are laid from the remaining timbers to the concrete so that in case any small pieces of rock should fall they would be caught on these planks, or if a large rock should come loose it would be impeded by the planks and would give warning in time to permit the men to get out of the way. The amount of timber taken down at one time depends upon the apparent safety of the rock above, and from 5 to 20 ft. is accordingly taken down.

The erection of the forms consists of placing a steel channel rib, bent to fit the cross-section of the tunnel, and connecting it with the last rib previously placed by means of steel plates 4 ft. long and 3 ft. high. These plates are built up solid to the top of the arch, since placing the concrete by the compressed air method permits the forms to be built complete before concreting begins. The steel ribs of the forms are 4 ft. apart, corresponding to the length of the plates, and from 1 to 5 sections are set up and concreted at a time, depending upon the character of the rock.

The mixing and placing outfit consists of a pneumatic concrete mixer and conveyor mounted upon a 40-ft. flat car, equipped with triangular shaped bins holding 26 cu. yds. of material. The cement is stored in bags under one of the bins and discharged toward the center of the car through chutes into a measuring hopper. This measuring hopper is lifted and tilted automatically to discharge into the mixer. The lifting device consists merely

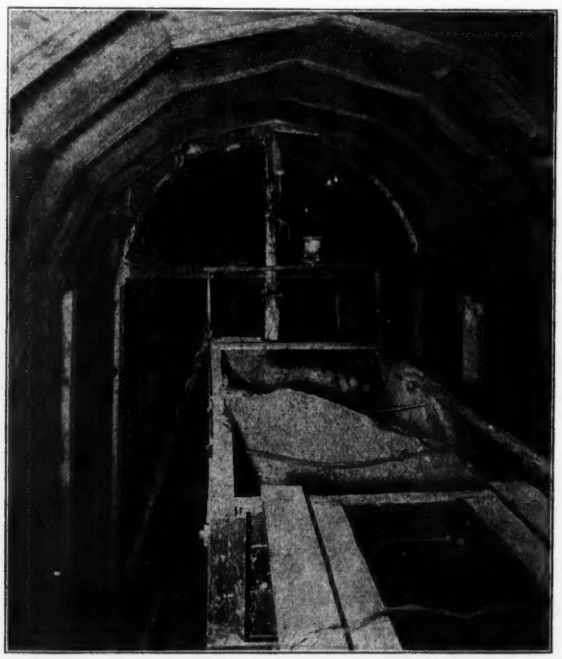


Fig. 2. View from Top of Mixed Car Showing Delivery Pipe Entering Forms at Crown of Arch.

of a 6-in. air cylinder. The 8-in. delivery pipe leads from the mixer under the car and vertically up at the end to the crown of the arch, where a 90 deg. elbow enters through the bulkhead of the form. Air is supplied from a compressor at the mouth of the tunnel through a 4-in. main laid on brackets fastened to the timber posts and a connection is afforded from this main to the air receiver on the car by means of a hose.

The proper size conpressor to run a portable outfit of this kind is about 300 cu. ft. capacity of free air per minute, compressed to 80 to 100 pounds. In beginning the work, however, a compressor of 134 cu. ft. capacity was furnished by the railway from one of its yards, as this was the only compressor available at that time. This compressor was operated by a gasoline engine and was found to be so badly worn and inefficient as to furnish only approximately 80 cu. ft. of air per minute. This, of course, effected a reduction upon the output of the mixer and conveyor and is mentioned because it applies to the data given below.

The mixing car is loaded by means of a portable derrick

handling a wooden skip, which is loaded by several men shoveling the bank run gravel into it, and is then lifted above the bins on the car and dumped into them.

The car was taken into the tunnel by a dinky engine and spotted at a point next to the forms. The upper elbow of the delivery pipe was previously suspended in place so that when the car was spotted the upper pipe was bolted to the pipe on the car, which comes directly under it. The air connection was then made and concreting immediately begun.

The first work done by the outfit, which includes the filling of the first 20 ft. of forms, required 5 carloads of concrete material. For this section the entire work of tearing down timbers required 128 men hours; the time necessary for erecting forms was 229½ men hours; the loading of gravel and cement onto the car required 140 men hours; the total time required for mixing and placing concrete in the forms was 204 men hours, the total yardage placed being 132 cu. yds. From these figures it is seen that the number of men hours required for the various items per cu. yd. of concrete were as follows:

	Men Hrs. per Cu. Yd.
Tearing down and clearing timbers	.97
Erecting forms	1.74
Mixing and placing concrete	1.5
Loading gravel and cement	1.06

The delays noted on this form were 3½ hours delay on account of blowing off an 8-in. nipple and replacing the same, and 2 hours delay on account of a derailment of the derrick car.

The substitution of a clamshell bucket, when available will cut the cost of loading the car to about ⅓ men hours, or say, 10 cents per cu. yd. and the substitution of a 300-ft. compressor will make it possible to mix and place one batch per minute. The number of batches on the car varies between 112 and 118. The time required at present to unload one car, including time of transporting and for connecting and disconnecting pipe, is about 3½ to 4 hours.

The concrete mixer and conveyor used for the work, was furnished and the portable outfit was designed by the Concrete Mixing & Placing Co., 123 W. Madison St., Chicago, Ill.

LONG CONCRETE CULVERTS, LEWISTON-GREAT FALLS LINE, C., M. & ST. P. RY.

The Lewiston-Great Falls Line of the C., M. & St. P. Ry. has been completed and turned over to the Operating Department as the Northern Montana Division. The line is 137 miles long and runs through the famous Montana "bench-land" of Fergus and Cascade counties, which is interesting from the engineering as well as scenic, traffic and operating viewpoints.

In an engineering sense this country is difficult, for the benches are high, sloping gradually to the river level, and to construct a line of low grades requires much bridging and many viaducts. To keep the line well up necessitated the building of long concrete culverts and high embankments to care for cross drainage, and the work from where the Belt Creek drainage is encountered to Great Falls is unusually difficult where some of the fills are from 90 to 150 feet in height. The following table gives the size and length of some of the more important concrete arch culverts:

Name.	Size.	Length.
12-Mile Coulee	16'x12' 6"	237'
13-Mile Coulee	10'x 8'	244'
Squaw Coulee	16'x12' 6"	198'
Scotchman's Coulee	20'x15'	226'
Rogers' Coulee No. 1	18'x14'	214'
Rogers' Coulee No. 2	14'x11'	282'
Box Elder Creek (double)	20'x15' 6"	189'

Besides several large and interesting steel viaducts there are six tunnels on the line with an aggregate length of 2,728 feet, the longest one the Sage Creek Tunnel, being 2,000 feet long. These tunnels are all lined with concrete and are 16 feet wide and 21 feet high.

REINFORCED CONCRETE IN RAILWAY BRIDGE WORK.*

An interesting and rather surprising fact brought out by a letter canvass was that a large number of roads use no reinforced concrete structures. This is shown in Fig. 1, a table showing types of reinforced concrete structures in use on various roads. The number of roads not using reinforced concrete structures is no doubt greater than the table would indicate, for many of the roads not reporting probably do not use them.

The table shows that reinforced box culverts and deck slabs are the most used structures with retaining walls and trestles next in line.

In Fig. 2 is shown the tabulated data on design of deck slabs. This discloses the fact that there is practically no uniformity in design on the different roads. It is of interest to note that one road (the A. T. & S. F.) uses a live load equivalent to Cooper's E-70, no doubt the heaviest in use. The C. M. & St. P. Ry. has over 7 miles of single track deck slabs in use.

The report contains many standard designs of different structures, some of which have previously been illustrated in *Railway Engineering*.

The report shows that square twisted and deformed bars are generally preferred to the plain round bars. Billet stock is specified on all but one road.

The arrangement of bars in the same type of structures are quite different on the various roads, this is apparently on account of methods of construction and not design. Some roads use only straight bars or bars with short bends at the ends, while others use bars with four to six bends.

It is quite generally accepted that bent bars, if made true to

	TYPES OF REINFORCED CONCRETE STRUCTURES IN USE									
	ARCHES BARREL TYPE	CULVERTS (BOX TYPE)	CULVERTS (ARCH TYPE)	ABUTMENTS SOLID	ABUTMENTS (OPEN OR BENT)	PIERS	TRESTLES	DECK SLABS	RETAINING WALLS	CITY SUBWAYS
Number of Roads on which type is reported in use	16	30	15	18	13	15	17	28	23	15
Mileage of Roads on which type is reported in use.	61270	106972	48559	67580	52992	55932	76808	104776	81120	10864
Total number of Roads reported										54
Total mileage of Roads reported										163449
Number of Roads reporting no reinforced concrete structures										13
Mileage of Roads reporting no reinforced concrete structures										24864

Fig. 1. Table Showing Types of Reinforced Concrete Strustures in Use on Various Roads.

form, and properly placed in the structure, will fulfill the requirements of design better than a conbination of straight bars. They eliminate the sharp turns in the direction of the reinforcement, and give a continuity of reinforcement that is not obtainable with straight bars. An advantage in construction from using bent bars is the smaller number of bars to be handled and placed, a single bent bar being made to do the duty of several straight ones.

There are, however, other considerations than design that enter into the selection of reinforcement, such as methods of handling, shipping and placing bars, facilities for bending bars in the field; and skill and training of men on the work. Manifestly a road with a good organization of well trained foremen and workmen, and ample facilities for bending and handling bars, would be less restricted in the type of reinforcement than a road dependent on contractors, or with a less effective organization of its own.

Considerable variation is found in the allowable working stresses of both concrete and steel. A certain amount of variation would be expected, due to differences in the material used in the concrete, and to the impact allowances in the load; but these do not entirely account for the wide range. These variations must be attributed in part to the confidence, or lack of confidence, that designing engineers have in the strength of the material and in their ability to analyze the conditions of the structure under load. It is not to be expected that the working stresses for reinforced

*Abstracts from report of committee American Railway Bridge and Building Association, Los Angeles, Cal., Oct. 20-22, 1914. A Summary of Practice on 54 Railroads.

concrete can be brought even near the uniformity that obtains in the working stresses specified for steel structures. There are too many uncertainties in both analysis and construction, and these can best be covered by a liberal excess of strength in the design. Designers will have more confidence in their analysis when they have been verified by the results of exhaustive tests. Such tests can best be carried on at the engineering experiment stations of the universities. To be conclusive and exact enough to eliminate the possibility of abnormal results they should be conducted under conditions that approximate actual working conditions as nearly as practicable.

The tests conducted by Mr. Abrams at the University of Illinois and published in Bulletin No. 71 of the Engineering Experiment Station, have added a great deal to our information on the strength of the bond between concrete and steel. In this series of tests the plain round bars made a very creditable record. The bond resistance per unit of surface for square twisted bars was only 88 per cent of that developed by plain round bars. If the cross section of the bar be made the basis of comparison it will be found that the square twisted bars developed practically the same bond resistance as round bars of equivalent section. In the light of these tests Mr. Abrams concludes that "the results found with the twisted square bar does not justify its present popularity as a reinforcing material." These tests also proved that under ordinary laboratory conditions the deformed bar is no more efficient than the plain round bar. It was not until the conditions of initial failure were produced that the deformed bar developed bond resistance higher than the plain round bars.

DECK SLABS

1	2	3	4	5	6	7	8	9	10	11
RAILROAD	PROPORTIONS OF INGREDIENTS IN EACH PART OF STRUCTURE.	CHARACTER OF AGGREGATE	REINFORCING BAR	MAXIMUM ALLOWABLE STRESS POUNDS PER SQUARE INCH: TENSION IN STEEL Fs	COMPRESSION IN CONCRETE Fc	SHEAR IN CONCRETE S	ADHESION OF STEEL AND CONCRETE A	RATIO OF MODULUS OF ELASTICITY OF STEEL TO THAT OF CONCRETE FOR WORKING STRESSES n	LIVE LOAD EQUIVALENT TO COOPER'S CLASS E	IMPACT
A.C.L.	1:2:4	WASHED GRAVEL ¾" MAXIMUM DIAMETER	DEFORMED BILLET STOCK	16000	600	30	100 175	15	E-60	$\frac{L^2}{L+D}$
B.&M.	ALL REINFORCED CONCRETE STRUCTURES IN ACCORD WITH A.R.E.A. SPECIFICATIONS									
A.T.&S.F.	1:2:4		DEFORMED BILLET STOCK	15000	700	30	150	15	E-70	
B.&O.	1:2:4	CRUSHED STONE.	PLAIN OR DEFORMED	16000	600	60	50	15	E-50	50% OF L.L.
CENT. OF GA.	1:2:4	CRUSHED STONE OR GRAVEL	TWISTED OR DEFORMED BILLET STOCK	16000	650	120	150	15	E-55	100% OF L.L.
C.B.&Q.	1-CEMENT TO 4 GRAVEL	GRAVEL CONSISTS OF 1 PART FINE & 2 PARTS COARSE MATERIAL WELL MIXED	DEFORMED BILLET STOCK	18000	800	200	200	15	E-36 OR OVER	50% OF L.L.
C.G.W.	1:2:4	CRUSHED STONE OR GRAVEL GRADED SIZES ¼" MIN. DIAM.	DEFORMED	17000	750	120	100 150	15	E-55	50% OF L.L.
C.M.&St.P.	1:2:4	CRUSHED STONE OR CRUSHED GRAVEL 2" MAX.	DEFORMED OR TWISTED BILLET STOCK OR REROLLED	16000	700 FOR BY TRANS. FIBRE IN BENDING	90	PLAIN BARS) 50 DEFORM. 100		E-55 E-60	$\frac{L^2}{L+D}$
C.C.C.&St.L.	1:2:4	CRUSHED LIMESTONE	DEFORMED BILLET STOCK	16000	700	50	PLAIN BARS 50 DEFORMED BARS 120	15	E-60	$S\left(\frac{200}{L+30D}\right)$
C.&N.W.	1:2:4	CRUSHED STONE 1" MAX. DIAM.	SQ. TWISTED OR DEFORMED BILLET STOCK	12000	660			15	E-55	50% OF L.L.
C.R.I.&P.	1:2:4	CRUSHED STONE GRAVEL	PLAIN AND DEFORMED BILLET STOCK	15000	650	30		15	E-55	50% OF L.L.
L.&N.	1:2:4	BROKEN STONE OR GRAVEL	TWISTED BILLET STOCK	RECOMMENDATIONS OF JOINT COMMITTEE				15		90% OF L.L.
E.J.&E.	1:2:4	WASHED GRAVEL	SQ. TWISTED BILLET STOCK	16000	650	40	100	15	E-60	50% OF L.L.
ILL. CENT.	1:2:4	CRUSHED STONE OR GRAVEL	DEFORMED OR PLAIN BILLET STOCK	17000	750	40	PLAIN BARS 80 DEFORMED BARS 120	15	E-55	$\frac{L^2}{L+D}$
K.C. SOUTH.	1:2:4	CRUSHED STONE OR WASHED GRAVEL	CORRUGATED TWISTED OR PLAIN BILLET STOCK	15000	600	35 TO 100 DEPENDING ON KIND OF REINFORCMT.	PLAIN 65 TWISTED 110 CORR. 150	15	E-60	40% OF L.L.
LEHIGH VAL.	1:2:4	CRUSHED STONE OR WASHED AND SCREENED GRAVEL	PLAIN AND TWISTED BILLET STOCK	16000	650	30	PLAIN 60 TWISTED 100	15	E-60	$\frac{L^2}{L+D}$
M.&St.L.	1:2:4 BOTTOM 2" OF SLAB BELOW END TO BE 1:2 MIXTURE	GRAVEL	DEFORMED BILLET STOCK	18000	650	75			E-55	$S\left(\frac{200}{L+30D}\right)$
Mo. Pac. Syst.	1:2:4	CRUSHED ROCK OR GRAVEL	DEFORMED BILLET STOCK	16000	650	120 WITH WEB REINFORCMT.	150	15	E-50	$S\left(\frac{200}{L+30D}\right)$
N.C.&St.L.	1:2:4	CRUSHED STONE (PREFERRED) AND GRAVEL	PLAIN OR TWISTED	16000	750	40	80	15	E-50	$S\left(\frac{200}{L+30D}\right)$
N.Y.N.H.&H.	1:2:4	CRUSHED TRAP ROCK OR WHITE STONE 2" MAX. DIAM.	SQUARE TWISTED BILLET STOCK	14000	650	40	80	15	12000 LBS. PER FT.	100% OF L.L.
N.Y.O.&W.	1:2:4	CRUSHED LIMESTONE	DEFORMED BILLET STOCK	16000	650	40	50	15	E-50	100% OF L.L.
PENN. (EAST.)	1:2:4	¾" GRAVEL OR ¾" CRUSHED STONE	PLAIN TWISTED BARS BILLET STOCK	12000	600	50	100	15	E-55 (ABOUT)	PER P.R.R. 1908 SPECIFICATIONS
PENN. (WEST.)	1:2:4	CRUSHED STONE PREFERRED	SQ. TWISTED OR PLAIN TWISTED PREFERRED	15625 @ 2·0 = 625 2·0 ALL WORK TOTAL WORK	625 2·0	50	BARS DEVELOPED PLAIN 90 DIA. SQ. 70 IN 75 DIA	15	MAX. AS IT ENTERS SERVICE OF 60000	NONE
N.Y.C.&H.R.	1:2:4	BROKEN STONE OR GRAVEL	TWISTED OR DEFORMED BILLET STOCK	14000	650	30	PLAIN 60 DEFORMED 150	15	E-60	$\left(\frac{200}{L+30D}\right)$
SOUTHERN	1:2:4	CRUSHED STONE	PLAIN ROUND BILLET STOCK	16000	650	40 PLAIN 120 DEFORM	80	15	E-55	50% OF L.L.
W.&L.E.	1:2:4	"RUSHED STONE OR SLAG	TWISTED OR CORRUGATED	16000	650	120	80	15	MAX. LOAD OF ANY TYPE E-60	90% OF L.L.

Fig. 2. Data on Design of Concrete Deck Slabs.

It is evident from the records of these tests that the value of plain round bars as reinforcing material may have been underestimated, and also that twisted and deformed bars may have been credited with much merit which they do not possess, or which does not become effective under practical working conditions. However, the fact should not be overlooked that vibration, which is so large an element in working conditions, could not enter into the results of the laboratory tests. Designing engineers may feel that the deformed bar offers a security against vibration and initial failure that fully justifies its use in spite of the excellent showing made by the plain round bar in the laboratory tests. However, since the claims for superiority of twisted and deformed bars over plain bars are based on their capacity for developing greater bond resistance, it would not be amiss for designing engineers to review their specifications in the light of these tests, with a view to making such revisions in the working bond stresses of the different types of bars as may be justified.

The committee advised that much valuable data and information received in the reports from railroads came to hand too late to be available for this report. It therefore recommended that the committee be continued with instructions to present its final report at the convention in October, 1915.

The committee:—O. F. Dalstrom (chairman); J. L. Simmons; L. D. Hadwen; J. A. Bohland; A. Montzheimer; C. J. Scribner; D. C. Zook.

CONCRETE FENCES — CARNEGIE STEEL CO.

DESCRIPTION OF TWO DISTINCT TYPES WITH COST DATA.

Concrete Fence with Reinforced Panels Between Posts.

At the Edgar Thomson works of the Carnegie Steel Co., at Bessemer, Pa., a very heavy fence, consisting of reinforced concrete panels between posts 8 feet apart, has been built. The posts are 10 inches square and 7½ feet high, with corners beveled and a pyramidal cap at the top. The reinforcement consists of steel rails anchored into the top of an old retaining wall upon which the fence was built. The forms for posts were set up and placed, filled with concrete, and as soon as same had hardened, the forms for panels were erected and the reinforcement placed. Each panel is a separate unit, a tongue and groove expansion joint being provided at each post. The panels vary from 8 inches thick at the top to 4 inches at the center of panel due to the paneling.

The forms for the ornamental caps were placed at the same time as the panels. The concrete used for all parts of the fence was of a 1:2:5 mixture. All edges of posts and panels were given a champer to remove the sharp edges, which break and become ragged unless the greatest care is taken in removing forms.

The cost of this fence exclusive of wall was $1.80 per linear foot, which could be materially reduced for a larger job by special equipment and by using lighter reinforcement, according to Mr. C. E. Dinkey, general superintendent.

Concrete Fence Posts.

A second type of fence was built of corrugated steel sheeting on concrete posts with a concrete curb or retaining wall about 18 inches high between posts. This fence, consisting of 88 bays 17 feet long, with a total length of approximately 1,500 feet, is placed as a guard fence between railroad tracks at the Mingo Junction station of the Mingo works of the Carnegie Steel Co.

These posts are of square cross-section, with a taper towards the top and end 7 feet above the footings, which are 20 inches square and 18 inches deep. The posts are reinforced with a ¼ inch bar in each corner extending into the footing. Between footings is the concrete curb upon which the corrugated steel fencing rests. This material is fastened to steel angles which are in turn fastened to the concrete posts by steel lugs cast in the posts. The cost of this fence is given as $1.36 per linear foot.

CURRENT PRICES—CONCRETE MATERIALS.

Portland Cement—The cement market has remained practically the same since last month, except in certain localities, and the demand is about the same. Prices given f. o. b. cars at points named, including cloth sacks, for which, in general, 40c per barrel (4 sacks) is refunded on return in good condition. Prices per barrel (including 4 cloth sacks) are as follows: Boston, $1.72; New York, $1.58; Chicago, $1.55; Pittsburgh, $1.45; New Orleans, $1.64 on dock; Memphis, $1.64; Cleveland, $1.65; Cincinnati, $1.68; Detroit, $1.54; Indianapolis, $1.63; Columbus, $1.67; Toledo, $1.59; Dayton, $1.65; St. Louis, $1.55; Milwaukee, $1.55; Minneapolis and St. Paul, $1.65; Kansas City, $1.43; Omaha, $1.48; Spokane, $1.65; Seattle, $2.30; Tacoma, $2.30; Portland, Ore., $2.30; Duluth, $1.73.

Crushed Stone—1½-inch stone, prices per cubic yard, f. o. b. cars in carload lots, unless otherwise specified. Boston, 80c per ton at the quarry; New York, 90c to $1.00, in full cargo lots at the docks; Chicago, $1.15; Spokane, $1.25; Portland, Ore., $1.15; Seattle, $1.25.

Gravel—Prices given are per cubic yard f. o. b. cars in carload lots unless otherwise noted. Boston, 75c; New York, 90c in full cargo lots at docks; Chicago, $1.15; Spokane, $1.25; Portland, Ore., 85c; Seattle, 75c; Tacoma, 75c.

Sand—Prices are per cubic yard f. o. b. cars in carload lots unless otherwise indicated. New York, 50c, full cargo lots at docks; Chicago, $1.15; Spokane, $1.00; Seattle, 75c; Portland, Ore., 85c; Tacoma, 75c.

Reinforcing Bars—The demand and prices in general about the same as last month. Pittsburgh base quotations on mill shipments f. o. b. cars are from $1.20 per cwt., with the prevailing extras on bars under ¾ inch or base. The following are quotations on base bars per 100 lbs. for mill shipments from other points, f. o. b. cars: New York, $1.36; Philadelphia, $1.35; Chicago, $1.38; Spokane, $2.20; Seattle, $2.00; Portland, Ore., $1.80; Tacoma, $1.75.

Shipments from stock are being made at the following prices per cwt. f. o. b. cars: Pittsburgh, $1.60; New York, $1.85; Cleveland, $1.80; Cincinnati, $1.85; Chicago, $1.85; Spokane, $2.50; Tacoma, $2.00; Portland, Ore., $2.00; Seattle, $2.20.

Metal Clips for Supporting Bars—$4.50 to $6.50 per 1,000, depending on size.

For the majority of the prices given we are indebted to the Universal Portland Cement Co., Concrete Steel Co., American Sand & Gravel Co., Chicago, and F. T. Crowe & Co., Seattle, Portland, Spokane and Tacoma.

Reinforcing bars for mill shipments are in general sold on a Pittsburgh basis; this is, at the Pittsburgh quotations plus the freight to the point in question, and with the following list of freight rates on finished material and the Pittsburgh quotation given, the prices of bars at any of the points listed can be readily computed.

From Pittsburgh, carloads, per 100 pounds to:

Albany	16 cents	Birmingham	45 cents
New York	16 cents	Columbus	12 cents
Philadelphia	15 cents	Cincinnati	15 cents
Baltimore	14½ cents	Louisville	18 cents
Boston	18 cents	Chicago	18 cents
Buffalo	11 cents	Richmond	20 cents
Norfolk	20 cents	Denver	84½ cents
Cleveland	10 cents	St. Louis	22½ cents
Minneapolis	32 cents	New Orleans	30 cents
Kansas City	42½ cents	Indianapolis	17 cents
		Omaha	42½ cents

That concrete piles are able to withstand shocks due to unusually severe driving was shown during the driving of 60-foot reinforced concrete piles for the foundations of abutments for the Norfolk and Western Railway's Farmville High Bridge across the Appomatox Valley, Virginia. The average penetration throughout the whole length was ¾-inch per blow and the final penetration was from 1/30 to 1/40-inch. Standing up under such severe blows speaks well for their design and construction and is a forceful testimonial to the strength of reinforced concrete piles.

New Books

FOUNDATIONS. By Malverd A. Howe. Cloth, 6x9 ins. 110 pages, 55 figures. Published by John Wiley & Sons, New York. Price, $1.25.

A short text-book on ordinary foundations, including a brief description of the methods used for difficult foundations, the object being to state in an elementary manner the fundamental principles upon which the proper design of foundations is based. Methods of designing various types of footing with illustrative examples are given.

The first chapter treats briefly of the supporting capacity of soils. This is followed by a chapter on wall and column footings of various types and one on piles and pile foundations treating wood and concrete piles and concrete pillars in a very brief manner. A short chapter on footings for chimneys and towers contains some valuable data. Various types of bridge piers and abutments and methods of building are illustrated and described in chapter 5. The final chapter treats of the general methods employed for difficult foundations, such as pneumatic and open caisson work and the freezing process.

The book is primarily a text book for engineering colleges and without doubt a good one, but entirely too brief for a reference work which must of necessity go more into detail. The book is well illustrated and written and forms a very valuable addition to our engineering text books.

HANDBOOK OF CONSTRUCTION PLANT. By Richard T. Dana. Flexible leather, 4½x7 in. 702 pages, 300 illustrations. Published by M. C. Clark Publishing Co., Chicago. Price, $5.00.

Contracting is rapidly becoming a systematized business instead of a "game" as it has so often (and rightfully) been called in the past. With this systematizing the necessity of close estimating and bidding has grown apace and mere "guesses" seldom land work which can be called profitable. It therefore has become absolutely necessary that the estimating department of any contracting firm, which expects to stay in business for any length of time, should have at its disposal complete information regarding various kinds of equipment.

The object of this book is to furnish this information to contractors in the most desirable form—that is, as regards cost, capacity, operating expense and adaptability to conditions governing the work. It is of course impossible to automatically tell the contractor what equipment to use, but it is possible to give him the data in tangible form with the "chaff" of ordinary advertising literature removed. In this the author has succeeded, to say the least, and the book bids fair to rival the now famous Gillette's "Handbook of Cost Data" in its particular field.

The subject matter is treated alphabetically, which facilitates the easy use of the book. Practically every type of equipment used in contracting is treated and the text is amplified by many illustrations and tables. For the man who has to buy, sell or use construction plant this book will prove invaluable, in fact it might be called the "Contractors' Baedeker."

SURVEYING MANUAL. By Howard Chapin Ives. Flexible leather, 4½x6¾ in. 296 pages, 82 illustrations and plates, and 13 good tables. Published by John Wiley & Sons, Inc., New York.

A very good manual of plane surveying designed particularly for the use of first year students in surveying, and especially for the use of non-civil engineering students. Methods of surveying, tabulating in field books and types of instruments necessary are plainly demonstrated and illustrated. The chapter on "Railroad Curves" demonstrates the different types plainly and graphically so that the student does not necessarily have to be a technical man to understand it. The book would be of service to any engineer in the field.

STEEL CONSTRUCTION. By Henry J. Burt. Leather, 4½x7 in. 372 pages. Numerous tables, illustrations, plates and text figures. Published by the American Technical Society, Chicago. Price, $2.75.

A text and reference book covering the design of steel framework for large office and business buildings. The book, though primarily a textbook, contains data of such a character as to make it a valuable reference work for the practicing engineer, giving as it does illustrations of the solution of practical problems encountered in tall steel building design.

Part I deals with the manufacture, testing and fabrication of structural steel; Part II with the design, practical applications and details of construction of beams and riveted girders. Columns, tension members and wind bracing are treated in Part III. The subject matter on wind bracing is excellent and since this important matter is usually almost entirely neglected in books of this kind the value of the work is greatly enhanced. Under the heading of "Practical Design" is presented a complete set of drawings and detailed explanations in connection with the design of the sixteen-story Fort Dearborn Hotel, Chicago, built in 1913-14. This feature is indeed unique, giving the student a most excellent idea of methods of supporting curtain walls by means of spandrel beams, how to lay out framing plans, methods of detailing and such other things which the usual textbooks on theory and design omit entirely. Part V deals with the protection of steel from rust and fire and the general characteristics and examples of typical specifications.

Mr. Burt's intimate knowledge of the structural design of tall buildings has enabled him to write a book which is essentially different and vastly more practical than the usual books on steel construction.

MODERN STORM DRAIN.

By Albert Marple, C. E.

In the construction of this modern storm water drain system a county and a railway company combined, the object being to protect both the property of the company and also that of the county. In effect it has been found to be entirely efficient and is "standing up" well under extraordinarily trying circumstances. This concrete-lined ditch is 500 feet long and 24 feet wide. The wall on either side is 4½ feet high above and 3 feet below the surface of the ditch bed, being situated on a concrete vase 6 inches thick and 2 feet wide. The railway bridge is located at the "intake." It is 30 feet wide and as long as the width of the ditch. It has three supports which run below its entire width. Each of these is 5½ feet high, 2½ feet thick at the bottom and 30 inches thick at the top. These piers are also buried 3 feet in the sand and gravel and rest upon foundations 8 inches thick and 5 feet wide. The ends of the piers are sharpened so as to cut the water as they come in contact with it. During the construction of these piers four indentations were left in each upright, and into these four large beams, running the entire width of the ditch, have been placed. Upon these beams the ties for the tracks are located.

At the other end of this ditch, where the outlet is located, is the bridge over which the good road runs. This is 50 feet wide, 6½ feet high and has a face 2 feet in width. It has a single support which has a thickness at the bottom of 10 inches and at the top 8 inches.

This entire concrete work is reinforced by steel rods having a diameter of ½ an inch, so placed horizontally and vertically as to form squares 12 inches in diameter. The bed of the ditch has been lowered to the natural level of the wash on either end and is 4 feet below the property running along its either side. The drain was built jointly by the Pacific Electric Company and the County of Los Angeles, and is located near Monrovia, California.

The Cumberland contemplates an extension from Wheeler, Ky., to Jellico, Tenn., about 24 miles.

The Oregon Short Line will widen its viaduct on North Temple street, Salt Lake City, and straighten the west approach.

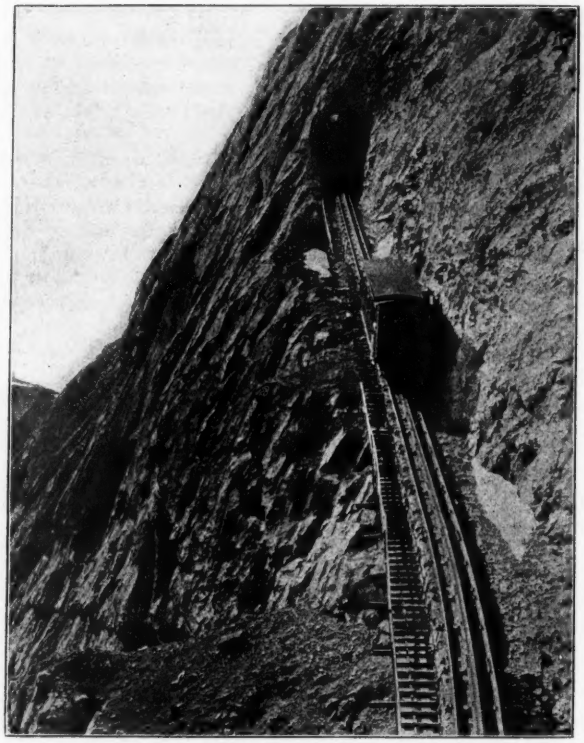
MOUNT PILATUS RAILWAY.

By Janet M. Cummings, New York, N. Y.

Interesting among railway construction features are the rack railways used for reaching the summits of high mountain peaks for the purpose of sight-seeing by tourists and also for transporting supplies to astronomical observatories that are often located on these peaks.

In rack railways a cog-wheel engine engages in a toothed rack, which is part of the permanent way. The earliest arrangement of this kind was patented in 1811.

One of the best examples of this form of construction is the Mount Pilatus Railway.



Cog Railway, Mt. Pilatus, Switzerland.

Mount Pilatus, one of the chief peaks of the Bernese Oberland, Switzerland, is 6,995 feet in height. The Locher rack employed on the Mount Pilatus Railroad is double, with vertical teeth on each side. The steepest gradient on the road is nearly one in two. This railway was constructed in 1886-88 by Locher & Co., of Zurich. It is about three miles in length, with an average gradient of 38:100 and a maximum of 48:100. The toothed rail has vertical teeth on both its sides and into this two pairs of toothed wheels attached to the train work horizontally. Both the engine and the passenger coach form a single car with only two axles. There are eight trains daily on the railroad, the ascent taking an hour and a half and the descent about ten minutes less. The round trip fare is 12 francs (about $2.40).

The railroad starts at Alpnach-Stad (an altitude of 1,437 feet). It gradually ascends, traversing meadows and then woods to the Wolfort Gorge and tunnel, at an altitude of 2,985 feet. It then ascends the stony slope of the Risleten (a gradient of 48:100) and passes through two tunnels, at which point the photograph was taken.

INTERSTATE COMMERCE COMMISSION DECISION.

As we go to press it is persistently reported that the five per cent increase will be granted by the Interstate Commerce Commission. If such action is taken, it will help the whole situation.

The Maintenance of Way Department

MY IDEAS OF PRACTICING ECONOMY

By a Section Foreman.

Last Sunday our roadmaster had all of us section foremen down in his office for our regular monthly meeting. After we had talked over a lot of things about our present track conditions and what we could do to improve our line and surface before the winter weather sets in, the roadmaster gave us quite a lecture on economy.

He told us that the war that is going on in Europe has knocked the bottom out of the business on our railroad because there are no goods coming in to the seaport for us to haul, and the grain and other stuff that we usually handle at this time of the year for export, is not moving because there are not enough ships to handle it. He also told us that the big manufacturers and other business men in this country cannot borrow the money they need to carry on their business, and this also makes business bad for the railroad.

All of us have noticed that there were very few freight trains running, but had not understood just what was the reason we were not handling more business.

The roadmaster went on to explain that when business was so bad it was of course necessary for the railroad to cut down their expenses, just the same as the grocer does in our home town, and we therefore would have to get along with less men in our gangs and must not order any material unless absolutely necessary to have it.

He talked to us so seriously on this subject that it set us all thinking how we could save money for the company besides getting along with less men on the section, and I studied the matter over a great deal while I was walking up through the yard from his office, looking over Clancey's section before No. 12 came in to take me home.

Just opposite the yardmaster's office there is a big commercial scrap yard where I noticed some men working, and when I stopped to watch them a while, I found they were unloading scrap and sorting it.

It is surprising to see how they took old truss rods, screwed off the nuts, dipped them in oil and saved them; took off the old turn-buckles, gave them a coat of paint so they look like new; cut off the rusted threads from rods and bolts and straightened them so they could be used over again. I asked the boss why they were doing this on Sunday, and he explained that the X. Y. & Z. R. R. had cleaned up a lot of scrap so they could raise some ready money, and had shipped him more than his gang could handle. I couldn't help wondering why, if the X. Y. & Z. people need money so bad they didn't put a few men at work on this scrap before they sold it and saved all this stuff which they surely could have used again themselves.

That made me think that I had seen lots of stuff in the scrap trains that are run over my section on the local once every month that is good to use, and I'm going to lay for these cars next month and pick out all that stuff so it won't get away in the scrap. It is just as easy to load it in a separate car or keep it separate in one end of the scrap car as it is to mix it up in the scrap when we load it.

A little further along I came to Clancey's car house and my key fitting his lock I took a look inside. It looked very much like my own at first, but as I had the economy bee in my bonnet I noticed a number of things that didn't look right to me.

There were three kegs of track bolts standing back in the corner of the house with heads knocked in, bolts all rusted, and as far as I could see no nuts in the kegs to use on the bolts. Over near the door there were two kegs of new bolts which had not been opened. I tipped over one of the old kegs and found a number of good nuts mixed in with the bolts near the bottom of the keg, and a little later when I looked at his scrap pile outside the house there were 25 or 30 nuts mixed up in the scrap which could have been used on the old bolts with use of a little oil. We've been getting new stuff pretty easy lately, so I suppose there didn't seem to be any object in working over this old stuff.

I found in this house what looked like enough pieces to make 25 or 30 good rail joints, except that he was short of wooden blocks. The other pieces were all mixed up so that a fellow couldn't tell whether there was as much as one good joint in the pile, but it surely costs the company some money to buy this stuff, and I have never had any trouble in getting extra wooden blocks from the supply car when I ordered them. I am going to make it a rule that all of the surplus rail joints on my section must be kept matched up and full bolted with a light coat of oil over the whole thing to prevent rust. Then I can tell what I have on hand and won't have to have a lot of good material tied up in such shape that I couldn't use it if I wanted to.

There were four kegs of new track spikes in this tool house. I could easily have sorted at least a keg of usable spikes from this scrap piled outside of the house if I would spend 15 or 20 minutes straightening them with a spike maul.

On my way down to the depot I noticed that one of the side tracks was laid with old main line rail taken out from some curves and instead of using the old angle bars they had got hold of a few new patent rail joints and had strung them along on this side track instead of keeping them on the main line according to instructions. I know that this section has got any number of angle bars on their main line rail and it seems to me it would have been a good scheme to apply these new patent joints on the main line and take off the old angle bars to use on the side track instead of the new joint.

We have been hearing a good deal about proper use of rail anchors lately, and as I walked along I noticed how they were using them on this piece of track. The steel didn't show much evidence of running, and as it was level, straight track in fairly good surface, I know I could hold it with two anchors in each panel, yet I didn't see any rail with less than three anchors on, and on one I counted no less than seven. This made me wish that I had the extra anchors that this man is wasting, as I have got some high speed track where the steel is running and so far this summer I have not been able to get any anchors to put on there.

As I sat on the stepping box on the back platform of No. 12 on the way home studying these matters over, I got to watching the ties distributed along the permanent way. Now I have got all my ties in for this year and thought every other fellow had too, but I was surprised to notice where some fellows have ties freshly distributed as if ready to put in during the next day or two. Now we haven't received any new ties for next year, so these must have been this year's ties which were unloaded somewhere else and then hauled out to the place where I saw them, on a push car.

This kind of work costs the railroad company a lot of money and for my part I cannot see any reason for it. A fellow isn't so busy during the winter months but what he can get a good line on his next year's requirements for ties, and when they begin to come late in the winter or during the spring he ought to be able to put them down right where he is going to use them. I'll bet I didn't move as many as 100 ties a distance of over three rail lengths on this year's work, and if we all watched the matter like that a lot of labor would be saved.

I was talking to my roadmaster on these matters a few days ago, and when he told me I ought to get someone to write my ideas on paper for me he fixed up a trip for me down to our division shops so I could see how they handled the scrap.

A lot of these mixed cars that we fellows load along the line with scrap rail, frogs, spikes and bolts and other stuff have to all be worked over at the big scrap yard because the fellow they sell the scrap to won't take anything else on a car excepting scrap

rail, for instance, and another car must be loaded only with scrap frogs and switches and so on. They were working about 125 men at this place unloading these cars, sorting the stuff over and loading it up again. I'll bet a lot of this could be saved if we fellows on the line loaded our scrap rail in separate cars from the other scrap so they wouldn't have to handle it all over at the main scrap yards.

It was surprising to see the number of rails that were sent in with angle bars bolted on to them and the good rail anchors, tie plates and track spikes that these fellows are picking out of the scrap and saving to use over. This struck me as a lot of unnecessary work, because if each fellow watched his own scrap close, used the good material instead of ordering new, the railroad would not have to buy so much and these fellows at the scrap yard would save a lot of labor in handling and sorting. I am certainly watching this stuff a lot closer now than I used to, and it is surprising how we can use this stuff over again instead of throwing it away. In fact when I wrote the roadmaster about my trip to the scrap yard, I told him it would be a mighty good idea to only send out such stuff as oil, torpedoes, flags and repairs for our switch lamps next month on the supply cars, and I believe every one of us can get along for one month without the other stuff which we imagine we have to have.

While I was at the scrap yard, I happened to see a spring frog in the pile which some fellow had thrown away because he had a wreck on it and the frog was pretty well bent up. The spring rail on this frog wasn't hurt a bit, and I happened to think of the right hand frog on the Canning Company's spur on my section. This frog seems to have a flaw in the spring rail where it is all battering out flat, while the rest of the frog is still good. The fast mail goes through here like a streak and I have been nervous about this frog for some time, but I thought it was too good to take out. I asked the foreman of the scrap yard if he would have the good spring rail cut off of the frog that I saw there, and ship to me, and I will just put it on my frog in place of the battered spring rail which I can ship back to him in the next scrap car.

I wonder if a lot of this sort of work couldn't be done without very much expense, and possibly save buying new material? These men at the scrap dock were loading all of the frogs to ship away to scrap dealers just in the same shape that we send them in from off the line, and I couldn't help thinking of the scrap men I saw working a gang Sunday in loading and cutting up this sort of stuff for the market. Now if it pays him to do this kind of work on Sunday, why wouldn't it pay the railroad to cut up their frogs before they sell them? We could save a lot of good bolts, spacing blocks and shoes which the supply car could furnish us from time to time in place of pieces that wear out or break. We could even use these good pieces in building new frogs, if our shop is fixed to do this work.

They were shipping away a lot of switch points at this scrap yard that were only worn on the tip and some that had been run through. These could be repaired at small cost or cut down to 12 ft. and we could then use them on our yard switches. I couldn't help but think how easy it would be to fit up this scrap yard at very small expense so all of the scrap from the shops could be cut apart and worked over, just like I saw the scrap dealer doing in his yard. A lot of these rods, bolts and other iron looked to me just as good as new and it surely would pay the railroad company to cut this stuff apart and use it over again instead of selling it to the scrap dealer who could afford to work his force Sundays doing the same kind of work on our scrap.

When I left the scrap yard I walked down through the train yard to the depot and ran across a brakeman of our local freight. I stopped in to visit him in his caboose a few minutes and found him busy cleaning up. He was washing his windows and drying them with a big bunch of white waste which looked to me like mighty fine stuff. I told him that we fellows on the section could only get colored waste, and not very much of that at a time, and asked him why he didn't use about one-fourth the amount of colored waste instead of that big bunch of white waste. He said he could get all the white stuff he wanted just by asking for it, and didn't have to use the colored waste which wasn't so nice to handle. He then showed a pile under the seat of his caboose, and it must have been 25 or 30 pounds. I'm sure this stuff costs a lot more than the colored waste and think the storekeeper should be more careful about giving it out on orders.

If the superintendent ever looks through this caboose he will find about 40 good journal brass, four journal jacks, two pair of car replacers and enough chain and rope to run a good wrecking outfit. Now if every caboose carries a pile of stuff like that, it represents a lot of money tied up, and if the trains get over all the sections like they do over mine, I don't think they use very much of it on a trip. If they were to go through all the cabooses at this terminal and clean out the stuff that is of no possible use to the crew, there would be about a carload to send back to the storehouse.

A little further up, just outside of the shops, I saw a force of men turning over a string of 30-ton box cars, which they burned while I was watching. This seems to me like an awful waste of material, because a lot of this lumber was good for firing engines, at least, and the car sills would make mighty fine stuff for platform curbing, foundations for small buildings and other purposes. It looked to me as though the iron work of these cars was badly damaged by the heat, and a lot of the bolts and rods could have been used if the nuts had been screwed off and saved, instead of burning the wood off in the fire.

The more I study over the different ways to save money on the railroad, the more things I see that our boys are doing which they shouldn't.

The train crews brass a car on the passing track and leave the old dope lying there. This stuff contains a lot of oil and it surely is good to use over again if they would mix it up with a little fresh waste and oil. I should think they would carry a pail to pick up this stuff and use it over again. Sometimes when they are in a hurry they even leave the old brass lying there, too. This is a bad plan, as someone is liable to steal it.

I have seen our agent deliver No. 19 orders to an engineman by means of a hoop and the engineman toss the hoop off into the weeds. I stopped the hand car each side of the station one day and picked up eleven of these hoops, which must cost money when first bought.

The trouble is nobody thinks about these things, and the railroad officials who are concerned with such matters as expenses, cost of material and supplies and similar matters are too busy to tell us how much these things cost and the little ways in which we can avoid wasting. I am sure if the question of economy could be brought as forcibly into the mind of every railroad employee as it has into mine during the past few weeks, we could save many thousands of dollars a month on this system.

RAIL CREEPING, No. 22.

By A. Palme, Roadmaster.

Rail-creeping on double track I know very little of, as very nearly all my track experience has been gained upon single track roads.

Much of the matter submitted in this discussion no doubt will be given from a scientific standpoint; many opinions will be given as to the cause and the remedy thereof by men who have given much of their time to the theoretical study of this grave subject. I will leave the theoretical part of this question to them and do as grandma does when there is a sick child in the house—give a few home remedies, confining my deductions to the rail in itself.

We all know that when there is a force applied to the rail that is greater than the resistance or counteracting force the rail will creep in the line of the least resistance. Many methods have been tried to prevent rail-creeping, very few of which have proven efficient. Why? Force was greater than the resistance. Methods that are effective in some places prove to be ineffective in others. The most effective method now in use is that in use on street railways, burying the heavy girder rails in the concrete, asphaltum and other street materials until only the treadway and guard flanges

are exposed, this giving a greater resisting force than any of the other forces that are applied to the rail and renders it stationary, and the temperature of the rail remains almost normal throughout the year; but we cannot consider this method on transcontinental and interurban railways, as the cost is prohibitive. These railroads can consider one point only—the greatest efficiency at the least cost.

Rail anchors, anti-creepers and other devices have been tried, but no device has been found that has proven effective in all cases.

While much is said about rail-creeping in the direction of the heaviest traffic, I find at times the rail-creeping in the opposite direction. This is due to improper expansion—in fact, I claim that most of the rail-creeping is caused by the rail being laid too "tight."

I am not advancing this opinion theoretically; I am speaking from actual experience. On construction work the resident engineer will almost invariably insist upon the use of a thermometer to gauge the amount of expansion to be given at certain atmospheric temperatures; this has proven to be deceptive. An illustration: Some time ago I was in charge of track laying, taking charge after about ten miles had been laid. While inspecting the work that had been laid I made the assertion that the "steel" had not been given enough or proper expansion. The engineer to whom I made this assertion stated that it had been laid according to the standard rule for expansion. I still insisted that the "expansion was too tight." We were discussing this at the end of a long trestle. I asserted that before the track laying was completed he would find the ties spiked in the slots of the angle-bars on the bridge would be fractured by the rail creeping. Very shortly afterward my contention proved correct. From 6 to 8 cuts of 5 inches in length were made per mile for several miles. These cuts were made upon extremely hot days.

We began the cutting at points where the ties had not moved; pulling the spikes from the slots of the angle-bars in the direction that the track had been creeping, the five-inch piece was knocked out and the rails would creep back to where they were originally laid. The next cut was made at a point where the joint was inclined to show that it was slightly ahead of its original position. We continued this until all of the "tight" rails were relieved. As this was done in the very hottest part of the summer, we did but very little "bucking" of the rail. The heat was so intense that with very few exceptions it closed the gap where the five-inch piece was removed without the assistance of the buck-rail. On embankments and in cuts the joint ties that were pulled ahead by the rail creeping were driven back and all of them and those on the bridges were re-spiked in the slots of the angle-bars. Although the traffic increased over 400%, the loaded cars all going in the same direction and returning empty, this track showed no further signs of creeping.

When I began to lay the unfinished portion of this track much criticism was offered by the engineer as to the "expansion" I was giving, he claiming that I was giving too much. He consulted the thermometer which hung upon the side of the "pioneer-car" and was comparing the shim I was using with the schedule he had in hand. I gave him this explanation: "You are taking the atmospheric temperature and are relying absolutely upon it for the basis upon which we must calculate thickness of the shim or templet to be used in making the proper separation between the rails to insure the requisite contraction and expansion. You are eliminating the first and only point that should be taken into consideration, the temperature of the rail. While the atmospheric temperature is now registering 78°, you will find by placing your hand upon the rail just coming from the car that it is quite cold." We took the thermometer and placed it between the rails on the cars and the temperature of the rail registered 54°, or 24° less than the atmospheric temperature, thus proving the fallacy of relying upon atmospheric temperature to compute the separation that must be given to control the expansion and contraction.

Very much of the creeping track during construction is due to full bolting the track before it is ballasted; by using only two bolts to the joint the track will be weaker at the joints and will contract and expand quite evenly, otherwise if full-bolted the track will "sun kink" on account of being too rigid at joints, and in most cases rails will have to be cut, especially in this Western country, where we sleep under blankets at night and the temperature rises to 105° to 106° at noon.

The principal reason (or rather excuse) for rail being laid too tight is this: when foremen are laying or relaying "steel" the order is made to rush the work, and quality is sacrificed to procure quantity. When relaying the foreman on many occasions must furnish his own shims, and when this is the case he uses nails, pieces of wood, the point of a spike and more often than otherwise nothing at all, for the order of the day is to "cover the ground," and with very few exceptions the extra gang foremen will cover it; the resultant cost is dollars where they have given the impression of having saved cents.

In supported joints I have no confidence. They are conducive to "bunching the expansion;" the rail ends bearing on the tie allow sand and dust to collect and become solidified between the ends of the rails, causing the rails to creep in the direction of the least resistance, which usually is down hill, or if the track is lightly filled in will cause the track to "sun-kink." The suspended joint eradicates this, yet I have found track creeping where suspended joints are in use, but I attribute most of this to the rails being laid so close together that the rails are not allowed to fully expand, thereby causing the rail to creep down and "bunch" at the foot of the grade, making it necessary to cut out a section of rail at that point to insure good alignment.

Bolts being tightened until the angle-bars adhere to the rails as if welded is another serious mistake, and in a large measure the prime reason for track creeping. Several very tight joints (held rigid by the angle-bars being bolted too tight against the rail) in a place and a few looser ones further down the hill will cause the track to creep in that direction; the looser joints are forced to take up the "expansion" that should have been taken care of by the tighter joints. Idealists will say that these conditions should not be allowed to exist; but in my twenty-five years' experience I have not found a mile of track that was perfect in every detail. In all of the annual track inspections that have been held there has not been recorded a section that was 100% perfect.

A number of years ago when stub switches were largely used I had in common with other trackmen much trouble with the rails contracting in the winter and expanding in the summer. I concluded that as the rails crept toward the head-chairs in the summer time and away from them in the winter, that here existed a condition that could be remedied. After trying several experiments I found a solution of the problem, which was very simple. I removed the angle-bars, dipped them in oil, then placed them back in track. This was done for twenty rail lengths, and during a very hot summer there was no trouble at all from creeping throw-rails; each rail cared for its own expansion and contraction.

A number of years later I was in charge of a gang engaged in making rail renewals, working on a hill where there had been much trouble on account of rails creeping; the old rail was equipped with tieplates and three rail anchors to each rail, still the rail crept down the hill. The new rail was laid with tieplates and continuous rail joints; before the joints were applied they were swabbed with crude oil at all points that came in contact with the rail. We were very careful in adjusting the expansion, having in mind at all times that each rail must control its own contraction and expansion. The new tieplates fitted snugly and no worn spikes were used.

I remained upon that division for two years afterward and no trouble was experienced from this track creeping. When this portion of the track was laid we drove old bridge bolts into the shoulder of the embankments and into the sides of the cuts at intervals of eighteen to twenty-rail lengths apart at right angles to a countersunk punch mark on a continuous rail joint, so that we could note at which point we would find the rail beginning to creep; after the rail had been laid eighteen months an inspection was made and the rail showed no sign of creeping. Oiling the rail joints before applying them has become recognized economic

practice; it has been clearly shown that oiled joints do decrease the cost per rail in labor when making rail renewals.

I am firmly convinced that heavy oil is an excellent anti-rail creeper. When care is taken while laying the rail to give enough opening to allow the rail to properly expand and contract, the track fully tie-plated, the spikes driven snugly to the rail and the splices oiled but very little creeping will be found. Of course I do not intend to try to impress you with the idea that I believe that anti-creepers could be eliminated entirely; yet I know that the changes due to heat and cold would be controlled by simply oiling the splices. This will allow the parts of the rail which come in contact with the angle-bar to move freely, as was intended when the angle-bar was first designed.

I have known of track creeping eighteen inches on a trestle which was approximately one-half mile in length. This rail was "bucked" back and two anti-creepers were applied to each rail, which have held the rail stationary up to the present time. The principal cause of this rail creeping was the angle-bars were not slot-spiked and the track bolts too tight. There is no doubt in my mind were the angle-bars slot-spiked and the angle-bars lubricated it would have been unnecessary to use anti-creepers. I contend that there are many instances in which rail-anchors are used, that a little forethought would have prevented their use.

All working parts of machines work in unison when well lubricated, and this applies to the friction parts of the rail-joints.

When it is necessary to use anti-creepers I do not favor the elimination of spiking the joints in the slots, for surely the ties that are slot-spiked will offer as much resistance as the tie which has an anti-rail pressing against it. The only objection that could arise to slot-spiking is that when the rail creeps it carries the ties with it, which is very good evidence that the angle-bar is doing duty as an anti-creeper, in connection with which it was originally designed, as well as that of splicing the rails.

RAIL CREEPING, NO. 23.

By W. A. Trimble.

The importance of keeping rail from creeping is acknowledged by all railroads, and the remedies suggested for the elimination of the trouble are many and devices manufactured for the purpose have flooded the market. It is hardly fair, however, to condemn a device for this purpose after only a tentative experiment, one that is effective a year or more and has undergone changes in weather and seasons may be passed upon with a great degree of certainty.

We do not consider it fair to pass upon the merits of a particular device unless the track conditions—at location of tests—were, or are, ideal, or at least in very good condition. We err in the assumption that rail in a piece of track over which heavy tonnage passes may be held properly by the simple application of anti-creeping devices, notwithstanding the fact that the line and surface may be bad, causing unwarranted horizontal thrusts, as does also improper elevation on curves, bad ties causing wave motion of the trains, bad joints, crushed joints, etc. Allowing the joint ties to get in bad condition works hand in hand with creeping rail, as it allows the leaving end of the rail to sag down, causing a heavy impingement on the receiving end of rail, and results in the rail being driven ahead, eastward or westward, as the case may be; the condition, however, is most generally attributed to creeping rail. It is our deduction that creeping rail is the result, to a very great extent, of neglected track work along some particular line; it may be bad line and surface, improper ballasting, bad drainage—a foe to all substantial track structure—or it may be the condition of the sub-grade.

I have knowledge of experiments conducted with several types of creepers in which excellent results were obtained. First, it is absolutely necessary in laying rail to use proper shims to take care of expansion and contraction. We use steel shims of the following thickness, according to the registering of a thermometer, which is always used when rail is being laid:

10 degrees below zero to 14 above use $\frac{1}{16}$ in. shim.
14 degrees above zero to 38 above use $\frac{1}{4}$ in. shim.
36 degrees above zero to 62 above use $\frac{3}{16}$ in. shim.
62 degrees above zero to 86 above use $\frac{1}{8}$ in. shim.
86 degrees above zero to 110 above use $\frac{1}{16}$ in. shim.
Above 110 degrees should be laid tight.

If the above schedule is carefully carried out you will insure sufficient space when rail is laid to take care of any or all contraction and expansion, and failure to do this very often starts new rail creeping the same day it is laid. It is also important to see that the joints are properly bolted, and that when new rail is laid or joined to old rail, slightly worn, step or compromise joints are used to guard against even a slight difference in the height of rail, this not only forestalling possible trouble with rail creeping but insures better riding track.

The experiment was conducted on a 3 and 4 track system. Nos. 1 and 2 tracks, for eastbound passenger and freight, for a

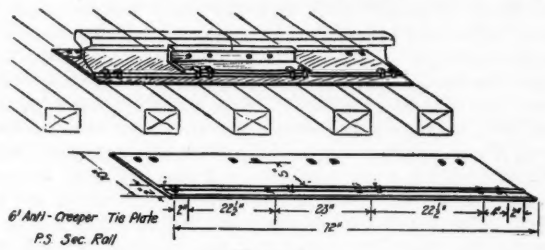


Figure 1.

distance of 28 miles being on a .3% descending grade, with a number of six-degree curves, some of which are compounded.

Over these tracks we have an average daily tonnage to date of 131,875 tons. When you consider this enormous axle load on a

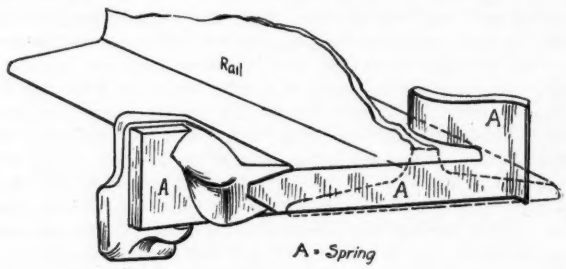


Figure 2.

slight descending grade at an average speed of 40 miles per hour, the excessive wave motion, etc., the tendency for track to creep is much above the ordinary, making it necessary to use at least 12 to 20 anti-creepers per rail length. The devices used must necessarily be of an extraordinary type. At present we have the 6 ft. anti-creeping tie plate (see Figure 1), which is suspended over 4 ties, 2 joint and 2 guard ties, used in conjunction with plain splice bars, and opposite each joint four (4) anti-creepers of either the type in Fig. 2 or type in Fig. 3. The device in Fig. 2 costs $0.16 complete, ready for application, and the spring part may be ordered separately and replaced for $0.10 per spring. There is no wear out to casting part, as it will last for years. The creeper, Fig. 3, has also proved very efficient; they have a lug on either side, which is a very commendable feature, giving them as it does more direct bearing on either side of the rail, thereby increasing the resisting qualities over that afforded by many other devices. The creeper costs approximately the same as does the Fig. 2 type.

The old style creeper (sketch No. 4), which consisted of a hook, bolt and lug, nut and nutlock, was extensively tried out, but under our heavy load eventually became loose, making noisy track. This loosening was caused principally by corrosion from drippings of refrigerator cars, making it impossible to tighten the bolts. This device cost the same as the two above mentioned.

The tracks on which these tests were made varied as to the sub-

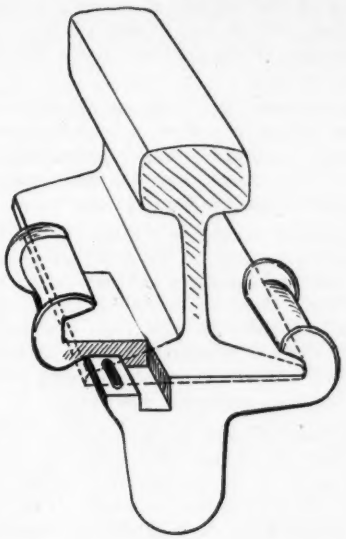


Figure 3.

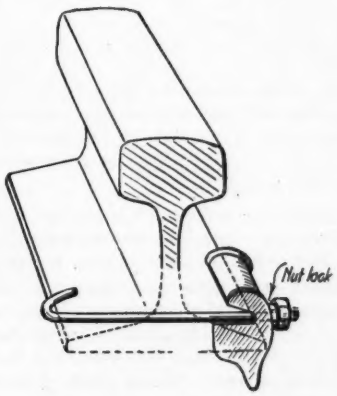


Figure 4.

grade, some on solid rock cut, clay and cinder fills. At one place we had to contend with a condition of impervious potter's clay at which point the drainage was especially bad, and this trouble had to be obviated before a fair test could be given. To do this it was necessary to install a series of French drains, carrying the water away by means of 24-in. cast iron pipe.

THE MAGNOLIA CUT-OFF OF THE BALTIMORE AND OHIO RAILROAD COMPANY.

With the opening of the Magnolia cut-off line of the Baltimore and Ohio railroad between Orleans Road and Little Cacapon, W. Va., a distance of 12 miles, on December 6, a new epoch was recorded in the history of the world's transportation which marked the completion of one of the largest improvements of the kind ever undertaken, as well as the most costly per mile of line and the last work of a budget of betterments commenced five years ago to build the only two main lines of four tracks each operated by one system and crossing two mountain ranges.

The cut-off cost the railroad company $6,000,000, or $500,000 a mile, and with other improvements involving the reduction of grades, elimination of curves, removal of tunnels and purchase of new equipment, the total cost of all the budget improvements has been about $100,000,000.

By reason of the geography of the Baltimore and Ohio railroad being such that two main lines from the west connect at Cumberland, Md., one from Chicago and Pittsburgh and the other from St. Louis and Cincinnati, each of which is fed by numerous submain and branch lines, the Magnolia cut-off solves a problem of transportation which has been a study of railroad experts in an effort to solve the problem of providing the most effective relief of the congestion which resulted from crowding the main tracks east of Cumberland. In solving this problem third and fourth tracks were added to the main line under a plan which eventually will provide a four-track railroad to the seaboard at Baltimore.

Coincident with the extension of facilities in the coal regions of Maryland, West Virginia and Pennsylvania and the growth of business of recent years, the eastern end of the Cumberland division of the Baltimore and Ohio handled the greatest density of traffic of any stretch of railroad in the United States, as over it there were moved 15,000,000 tons of freight a mile of road annually. The building of extra tracks facilitated the movement of freight to some extent, but it became necessary to "open the neck of the bottle" by adding the two main tracks known as the Magnolia cut-off. Chief engineers of the railroad had recommended it during the last 15 years, each under somewhat different plans as to the character of construction, cost and distance; and when the work was started an engineer representing the Japanese government established his identity with the work in order to study its progress.

Primarily the cut-off is an essential factor in the economics of transportation, for not only will it save about 6 miles in distance, but it will avoid a summit of the mountains for eastbound traffic and in this was effected an economy in the expense of train operation by doing away with the use of extra locomotives as helpers. The new line is almost straight as the crow flies between Orleans Road and Little Cacapon and eliminates 887 degrees of curvature compared with the original main line, which was built along the winding banks of the Potomac river in the days before engineering problems were conquered by such heroic measures. There is practically no grade over the new line. At certain points on the improvement the four main tracks are side by side, while at other places the new line crosses overhead on concrete and steel bridges and passes under mountains through tunnels.

To facilitate the train movement over this section of the road, automatic block signals and telephones have been installed in order to abolish the train order system and operate the line by signal indications.

The new line entailed the excavating of 3,500,000 cubic yards of rocks and earth, building four tunnels with a combined length of 7,100 feet, erecting 25,000 cubic yards of concrete bridgework, 50,000 cubic yards of concrete retaining and inter-track walls and removing 1,500,000 cubic yards of material from a cut 200 feet deep which takes the place of Doe Gully tunnel, where the four parallel tracks reach their highest elevation. The concrete was poured into the forms by gravity, and after being mixed was elevated to a tower 200 feet high. Still another feature is that but 3,000 tons of steelwork were used on the entire improvement. The four double-track tunnels are of extra width to handle the large Mallet engines and other heavy types which will pass over the line in regular service.

It is intended to operate the cut-off entirely for eastbound freight traffic, because of the economy possible and the further fact that the old line will avoid tunnels for passenger service.

Work on the Magnolia cut-off was started 18 months ago, under the direction of Francis Lee Stuart, chief engineer, and John T. Wilson, district engineer of the Baltimore and Ohio. It is one of the few large railroad improvements completed within the appropriation and contract time. While the contract was let in seven sections to as many contractors, and the work therefore was like so many individual improvements, it was so apportioned that each contractor completed his work during the same week, which was made possible by a recapitulation of the work by the engineers some months ago and certain parts of it "speeded up."

With the beginning of work on the cut-off, between 8,000 and 10,000 workmen and their families moved into the community.

This industrial army located chiefly in the hamlet of Paw Paw, which became a "boom town" in every sense. Rents soared and the high cost of living went skyward until the railroad came to the rescue and took charge of the welfare of the employees. Plans were gotten under way for a modern town, artesian wells were bored to provide pure water, electric lights were installed, churches, schoolhouses and community clubs were provided, equipped with musical instruments for the men. Physicians were put on the work to minister to the ills of the men and their families and to meet any accident emergency. Then the railroad built paths, or footways, over the mountain passes and posted signs along the work which urged the men to refrain from walking the tracks of the main lines. Police officers were stationed over the work to patrol it, instructing the foreign laborers in the use of tools and protecting them against vicious characters which usually infest a community of this kind.

The two double-track lines are in close proximity at numerous points where they do not parallel, the new line being frequently benched above the original tracks. As this meant that a great portion of the work was done under traffic, instructions were given that blasting be not done until the permission of the train dispatcher had first been secured. Special telegraph operators were employed to handle such messages, and before blasts were set off flagmen were sent out in both directions to stop trains and were not permitted to come in until a courier notified them. Signals were not relied upon to call in these flagmen. Experts in the handling of explosives had entire charge of the blasting.

It will be several weeks before the finishing touches are made on the new cut-off, but now that the track is in place and traffic is being handled it will be but a matter of mere detail to complete the ballasting of the line and remove the machinery and material from the work.

As previously referred to, the Magnolia cut-off is the last link in a program of improvements which has involved the rehabilitation of property and the expansion of facilities to place the Baltimore and Ohio abreast with the present requirements of traffic and to provide for the future as well.

The improvements included in the budget entailed the laying of extra tracks on the slopes of the Allegheny mountains on both of the main lines which converge at Cumberland. At the summit of these mountain tracks double-tracked tunnels were built, to avoid congestion, at Sand Patch, Pa., and at Tunnelton, W. Va.; and coincident with this safety tracks were built to protect traffic on the mountain, helper stations were installed, yards were built and enlarged and new equipment was added.

Soon after Daniel Willard became president of the Baltimore and Ohio railroad, in January, 1910, a study of the needs of the property was begun by him and officers of his staff, among whom were George F. Randolph, traffic vice-president; George M. Shriver, accounting vice-president; A. W. Thompson, operating vice-president; J. V. McNeal, financial vice-president; Francis Lee Stuart, chief engineer, and others of their staffs. In a public statement made by President Willard recently he said that the completion of the Magnolia cut-off would be the last work of the program as outlined.

EXCERPTS OF REMARKS BY SAMUEL REA, PRESIDENT, PENNSYLVANIA RAILROAD COMPANY.

THE RAILROAD SITUATION. THE NECESSITY FOR A CONSTRUCTIVE POLICY IN THE PRACTICE OF PUBLIC REGULATION.

Although holding no commission to speak for the railroads as a whole, the seriousness of their present position may warrant an expression of my views on the general railroad situation. * *

It is no difficult task to sum up the present railroad situation. We can all see that something is wrong, but no useful purpose will be served unless we can suggest some constructive methods of improving railroad conditions.

Examine, for instance, the eastern railroads, which reach the centers of the largest population and heaviest traffic of the country, and you will find greatly diminished gross revenues and a still greater proportionate reduction in net revenues; their purchasing powers are stringently curtailed, and their credit has been greatly weakened. This condition arises from causes largely beyond their own control, so that the return earned during the past year upon the money invested in the road and equipment of these railroads amounted to less than 4%. This serious condition is not new, but it is now acute. We have been living on hope at least since 1910, when the downward trend was clearly indicated; how much longer we can exist on that precarious asset I will not venture to say, except to suggest that it takes more than hope, advice or enthusiasm, or all combined, to pay wages and taxes, provide satisfactory service, pay dividends and retain a proper credit basis to obtain capital for improvements and extensions.

Increased traffic will not cure the railroad malady, for remember that up to the present all their economies and efficiency, obtained by increased train loads, etc., have been offset by increased costs, wages and taxes. These companies therefore need not merely the very moderate increase in rates for which they petitioned the Interstate Commerce Commission, but also all the revenue that can be secured by working out in practice the various other means suggested by the commission for increasing revenue.

A full consideration of the railroad position and the effects of public regulation must not however stop there. Irrespective of any decision in the rate case now pending, whether it be finally favorable (as we trust it will be) or unfavorable, it is evident that the time is ripe for suggestions concernng constructive railroad legislation and policy.

I need not remind you that after agriculture—and what would agriculture be without railroads?—the railroads are not merely the most important industry in the country, but they are also in their essence public institutions performing functions which are by their very nature of a public character. They are owned in part by an army of individuals actually holding their stocks and bonds, and in part by institutions such as savings banks, insurance companies, universities, hospitals and other philanthropic enterprises, in the welfare of which many more millions of individuals are vitally concerned. These are largely dependent upon income derived from the money they have invested in the service of the public, and rightfully they hold railroad managers responsible for this income. It should be the business of government regulation, not merely to see that the public is properly served by these railroad managers, but also to see that the owners of the properties are fairly compensated, and that their revenues are sufficient to properly discharge their duties to the public. Otherwise the management of these companies will be prevented from efficiently discharging their obligations to the public and their owners. The railroads must give the public good service and their operations must be continuous in good times and in bad. Moreover, the railroads of the country pay over $140,000,000 in taxes every year, a sum equal to 5% on nearly three billions of dollars, requiring over 16% of their net operating revenues. They pay good wages to their own employees and furnish profitable employment for the industries which furnish railroad materials and supplies.

But apparently the interests of everyone have been safeguarded under public regulation except the interests of those who furnish the money for the public service; and we must protect these investors upon whom we must rely for future capital. Failure in the last decade to protect the railroads and railroad investors has at last produced a lack of confidence in public regulation, and we now know that through the weakness of the railroads the whole country is suffering. Upon this great industry, through

the operation of too many hastily enacted Federal and State laws, and by failure to provide and adjust the machinery necessary to enforce these laws by reasonable and practical methods, a mistaken policy of repression has been imposed, which has not permitted railroad charges to increase with the enforced increase in the cost of their operations. This has caused loss to existing railroads, and has precluded the building of new lines, and the making of needed improvements and betterments on the present roads. The inherent weakness of the present situation is that we as a people seem to have assumed that the present railroads and their equipment and facilities are complete, and are sufficient for present and future needs, and that the chief function of public regulation is to curtail their revenues, increase their expenses and lessen the margin of return. In this growing country the present railroads are far from adequate, and therefore the policy of repression is bound to bring, if it has not brought already, a day of reckoning. Let us not forget that if we expect people to continue supplying their savings for our railroads, present and future, their earnings must continue to be what these investors regard as reasonable and sufficient, and they are not likely to be governed by the opinions of legislators or commissions in this respect. The present policy of repression must be modified and lack of confidence must be removed, or these millions of investors will seek other avenues to utilize their capital.

The railroads are existing under conditions that breed business depressions, because of arbitrary, heavy and frequently unjustifiable burdens imposed upon them by legislatures, state and national, and there are still many wasteful legislative experiments forthcoming unless the authors discover that the public will not willingly pay their cost. Public opinion is now convinced, I feel, that the railroads are entitled to more equitable treatment under public regulation, and that opinion and your very kind invitation have opened the way for me to offer some suggestions.

The present situation is not the result of premeditated action or of a clearly defined punitive public policy; it is the result of our failure to fairly adjust our national conception of the rights and duties of these common carriers, and to adapt our new laws for public regulation to rapidly changing commercial and financial conditions. It is not, therefore, a case for mere sterile criticism, but for mutual study and co-operation to the end that the evils now existing may be clearly recognized and corrected. The public, the railroads, and the commissions, state and federal, should unite in an effort to ascertain and finally establish the principles upon which wise regulation should hereafter proceed, so as to retain for the people at large the advantage of our American system of private ownership and operation under public regulation, and avoid being forced into another system far less desirable in a country such as this.

Under the existing federal law, increases in railroad rates, no matter how reasonable or justifiable, may be suspended without any hearing for at least four months after they have become operative. In practice this means five months after the rate schedules are filed with the commission, and the suspension may be extended by the commission for a further period of six months. It is, therefore, possible even if the new rates are justifiable, for the railroads to lose nearly a year of benefit from them while the commission is determining their reasonableness. Is the public welfare promoted thereby? From practical experience and in a spirit of fairness and justce, I should say it is not, and the period of such suspension, and the determination of the question at issue, ought to be restricted to sixty days after the date of filing new rate schedules with the commission.

Another trouble in the present situation is that the Interstate Commerce Commission has been overburdened with work and with responsibilities, many of which must be deputed to a large corps of subordinates, so that in many instances direct consideration by the entire commission is impossible. * * * * * * * The commission was given limited but well defined powers within reasonable scope. Now, however, as the result of new laws, the scope of its control of railroad operations and development has been largely extended. It could materially assist railroad development, but so far it has proven impossible for seven men in one center to act not merely as regulators but as administrators of the railroads, leaving the financial results and responsibility of that administration to be borne by the companies and their owners.

There is also a certain amount of disagreement between the federal and state laws and orders of commissions, and of failure to recognize the inroads on railroad revenues of new laws, orders and of governmental awards.

Let me use just one example of the commercial chaos resulting from such conflict. The recent difference in the views of the Interstate Commerce Commission, on the one hand, and the Public Service Commission of New York, on the other, in connection with the allowances to industrial railroads, has, during the last eight months, resulted in freight rates, via the lines of the New York Central (whose route is intrastate) from one of the large industries at Buffalo to New York City, and to other places on its line, lower than via any of the other trunk lines, as their routes between Buffalo and New York are interstate, and there is nothing that the other railroads could do to meet this situation, injurious as it was, not only to themselves, but also to industries local to their lines. The same situation, arising from the same cause, existed in the state of Pennsylvania, as between the Pennsylvania Railroad Company and other trunk lines. These differences must be reconciled for the welfare of the public and the railroads.

In the practice of public regulation, from the constructive side, I would at this time suggest:

First.—That the Interstate Commerce Commission should be materially increased, and so organized as to be able to deal promptly with the very important railroad questions affecting all parts of this large country, and thus conserve the time and energy of railroad officers, the public and the commission. The additional members of the commission should be selected from men having experience in railroad management, operation, traffic and finance, and if men of broad business experience were also added, it would be very helpful.

Second.—That the position should be placed beyond political influence by a long tenure of office, and with compensation sufficient to attract and retain men of the widest experience and greatest ability. We recognize the necessity for men of this character and technical experience in dealing with banking and other broad business enterprises, and we must recognize that equally wide experience is just as essential to deal intelligently and wisely with the railroad problems.

Third.—That the regulatory power of the Interstate Commerce Commission should be clearly extended to the supervision and control of all rates and practices which directly, or remotely, affect interstate transportation or commerce.

Fourth.—That the Interstate Commerce Commission should be given the power to interfere, by appropriate action, whenever necessary to maintain a rate structure approved by, or satisfactory to, it, even though, to accomplish this, it should be necessary for the commission to prevent reductions of rates which would have a contrary effect, or to compel advances of rates found by the commission to be unreasonably low. An unreasonably low rate may be beneficial to some one or more shippers, but the rates of some other shippers are sure to be disadvantageously affected thereby.

Fifth.—That for the existing repressive policy of public legislation a constructive policy should be substituted, and existing legislation should be so modified as to permit the railroad companies to do their full share in the development of the country's resources. It will naturally follow that the commission should be enabled, and indeed required, in the determination of questions involving railroad rates and practices, to deal with the questions before it not merely from the standpoint of the shipper and the carrier, but from the larger standpoint of the entire country, and on such economic and business lines that due and controlling weight may be given to these larger interests essential to the public welfare. Such a change in public policy and legislation is

requisite to encourage the investment of private capital for railroad extensions and additional facilities.

For instance, I seriously question the practical utility of railroad valuation, for I believe that very few railroads are overcapitalized, and I know the public is not required to pay higher rates on weak roads than on the more conservatively capitalized railroad lines. Therefore, while the railroads are cordially and fully co-operating in the work of federal valuation, yet under present conditions and when economies are being enforced everywhere, I look to the commission, under such an equitable public policy as I have in mind, not to commit the country and the railroads to so vast an expenditure until one system, or the lines in one section of the country, shall first be valued and the results demonstrated to the country.

Sixth.—That, as another necessary result of a constructive and equitable policy towards railroads, and with a commission amply strengthened to deal with railroad questions, Congress would no doubt refer to the commission for investigation and report such legislation as affected wages, employees' working hours and conditions, increased taxes, boiler inspections, extra and unnecessary men on trains, non-compensatory mail and parcel post service, railroad valuation, improved stations, grade crossing elimination, and other matters which seriously affect railway revenues and expenses. Due weight to these heavy expenditures would thus be given in approving rate schedules, and a tangible basis would be thereby provided on which to continue the regulation of these matters (if essential to the public welfare) without injustice to the railroads. The inability of the railroads to protect themselves in respect to increased wages fixed by governmental action could not be more forcibly presented than in the November, 1913, report of the Board of Arbitrators under the Newlands Act, relating to conductors' and trainsmen's wages on which your president served as chairman.

Seventh.—That the extraordinary power to suspend rates without a hearing should be limited to a period not exceeding sixty days after being filed with the commission, or some such reasonable period. If after such hearing as could readily be had within this period, coupled with the information and data already possessed by the commission, from the current and special reports made by the railroads, under its uniform accounting regulations, the commission could not be satisfied that the increase proposed ought not to be made, the rate should rightfully become effective and the present confusion and delay would end. The railroads as an act of self-preservation will always endeavor to make their service and facilities satisfactory and rates reasonable because only in this way can they make friends, encourage business and earn profits.

In conclusion I say that considerable emphasis has been laid upon the fact that the railroad companies and their owners are deprived of an appeal to the courts for the protection of what they conceive to be their just rights as against the orders of the commission. I am willing, however, to continue relying upon public regulation and public opinion to protect the railroads, although I cannot overlook the fact that the eastern railroads are earning a return of less than 4% on their property investment. If this is not approaching confiscation, how much less must we earn before reaching that point? Surely the country does not want impoverished railroads unduly restricted in the conduct of their business. What it does want is strong, aggressive lines, built and improved with private capital, efficiently managed and operated, subject to equitable public regulation.

What I have suggested may not meet all the difficulties in the public regulation of railroads. Other helpful suggestions will doubtless be forthcoming from railroad and business men and commercial bodies, etc., and, I trust, from some statesmen. There can be no difference of opinion that public regulation must be equitable so far as the railroads are concerned, and must be adjusted to promptly respond to business conditions. Such a change will encourage initiative and enterprise in railroad management and will assure investors, here and abroad, that their money has the full protection of our laws and that they will be equitably dealt with.

I believe in regulation by commission, and I urge, therefore, that we do not encourage destruction of such regulation, but rather its conservation, by adapting it, as we have banking regulation and other laws, to suit the needs of the country as they change from time to time. We must look beyond the present obstacles and view the whole subject from the statesman's standpoint. Under an enlightened policy of public regulation, but not repression, the railroads will be placed and kept in a strong position to meet increased traffic demands, as well as to live healthfully in times of depression. If we now by equitable dealing ensure their strength, one of the greatest obstacles to the recovery of financial confidence and business enterprise can be removed.

CURRENT QUESTIONS IN "THE BACHE REVIEW."

THE CONFLICT OF STATE AND FEDERAL RAILROAD CONTROL.

Interstate Commerce Commissioner Clements, in an address last week before the railway commissioners of the country, at Washington, clearly pointed out the great handicap under which railroads are laboring on account of the divergent and conflicting State policies which are at the basis of State rate regulations and continue to produce irritating and intolerable conditions of discrimination. He said that this feature of regulation demanded thorough and courageous action and that some remedy must be found. He suggested that it be through coöperative work.

A better way, it appears to us, would be through Federal incorporation. There are forty-eight railroad commissions in the country. They have 237 active members. They represent as wide a diversity of opinion as there are different classes of minds and different character of conditions in the whole country. To reconcile conflicting views and stubbornly held opinions under these circumstances by voluntary and unanimous action, would take years of strenuous persistence.

THE OUTLOOK.

Some most important events in financial history have taken place in the last two weeks. The Federal Banking system has commenced operations; the English loan of $1,750,000,000 has been over-subscribed; the Cotton Exchanges have resumed business and nearly all other exchanges throughout this country have either reopened, fully or partially, or fixed early dates for doing so. Cotton exports are increasing and other exports are steadily reducing our debt abroad by large figures.

But this will have a marked effect in establishing the confidence of investors in the quotations. Very large sums have been awaiting investment, but the owners preferred to hold them to purchasing in a market of a semi-private character, lacking confidence in the prices there made, because they were untested by the forces of public demand and supply. This test will now be furnished. There are always sums of money for investment whose owners are ready to buy at once rather than wait for speculative declines. This class of funds has been accumulating for the last three months and we would expect a very large volume to be employed in picking up the really good bonds for sale at prices which are attractive, whether or not in the future they go lower or higher.

Thus far general business has shown little improvement, but in some lines, with facilities available for furnishing war material for export, there has been unprecedented activity induced by large orders from the foreign warring governments. General business awaits, as it did before the war, for a revival of railroad buying to bring it to anything approaching prosperity levels. The Western crop country is universally optimistic on the future, but merchants in these localities everywhere report that at present the farmers, rich and growing richer, have not begun to spend, holding their money in hand. This is a curious manifestation and may be due to the wave of economy which has swept over the country. Rich and poor alike are saving every possible cent, all of which shoud result eventually in the accumulation of vast sums for investment.

The Signal Department

Signals and Interlocking, Jersey City Terminals, Central Railroad of New Jersey.

During the past three years the Union Switch and Signal Company have installed for the Central R. R. of New Jersey three large modern interlocking plants at the Jersey City terminals. Tower "C" at Communipaw terminal was put into operation on March 12, 1911; Tower "B", engine terminal, on June 1, 1914; and Tower "A," located at the passenger terminal proper, on November 15, 1914. These plants will all be equipped with the latest appliances and have signals of the upper quadrant type. The complete installation of Tower "A" will not be effected before next spring, and the signals at Tower "C" will not be changed from the lower to the upper quadrant until that time.

The most interesting features of the Tower "A" installation are the steel incased interlocking machine with lever light equipment, the complete combined boat and train starting system, and the unusually long cantilever overhang of the principal signal bridge.

The interlocking machine in Tower "A" is a 179 lever frame, in Tower "B" a 47 lever frame, and in Tower "C" a 71 lever frame, making a total of 297 lever frames handling the entire terminal, of which 249 are working levers, and 22 automatic signals, as shown in detail in the summary.

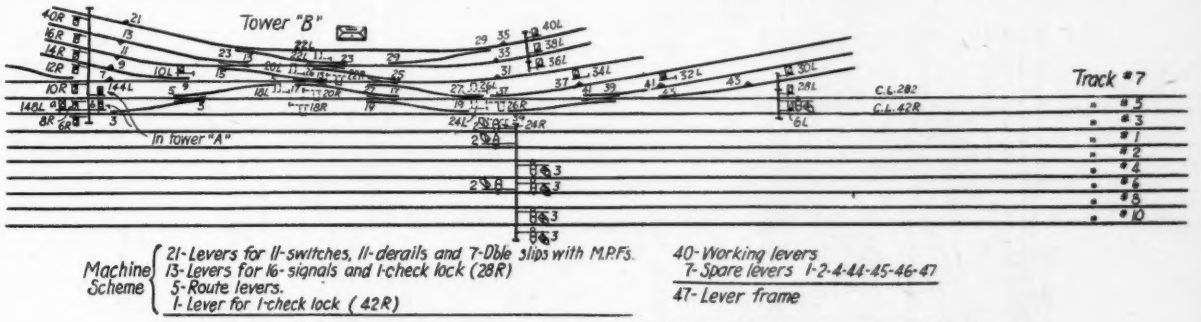


Diagram of Signals and Switches, Tower "B," C. R. R. of N. J., Jersey City Terminals.

SUMMARY OF LEVER EQUIPMENT, FUNCTIONS, TRACK CIRCUITS, ETC.

Tower.	Levers. Working.	Spare.	Single Switch.	De-rails.	Dbl. Slips & MPF.	Sngl. Slips & MPF.	Signals.	Lkg. Bet. Towers.	Trk. Cir.	Tot. No. Relays in Cabnt.
A	145	34	41	11	38	3	102	9	174	404
B	40	7	10	11	6	.	16	4	18	82
C	70	1	17	10	15	.	63	9	43	150
Automatics	...	..	..	..	..	.	22	.	19	...

POWER SUPPLY AND DISTRIBUTION

The power for the operation of these interlockings is alternating current furnished by the railroad company at 550 volts, 60 cycles, with an auxiliary feeder connected direct to the city service. At each of the interlockings an automatic circuit controller is installed which normally feeds the interlocking service from the railroad company's mains and connects automatically the power furnished by the auxiliary feeders in case of the failure of the railroad company's current. This arrangement, therefore, insures the continuity of operation of these interlockings in case the railroad company's feeders should become disabled. When power is restored to the railroad company's feeders, the interlocking is again automatically connected to it.

At each of the interlockings involved the alternating current at 550 volts is stepped down by means of oil cooled transformers to 110 volts. At this voltage the current is distributed for the operation of track circuits and signal lighting. Each track circuit is fed by a separate transformer of the reactive type eliminating all resistance or reactance coils usually employed in connection with A. C. track circuits.

At each signal bridge or signal location a small air cooled transformer is used to step down from 110 volts to 12 volts for signal lighting. This arrangement permits the use of 12 volt, 2½ watt lamps. These lighting transformers are fed by a separate bus controlled by switches located on the switchboard in the tower. Storage batteries are used for supplying direct current for the operation of switch and signal circuits. These batteries are charged by mercury arc rectifiers.

Air furnished by the railroad company at a pressure of 80 to 100 lbs. per square inch is used for the operation of all switches, slips and signals. Two and one-half inch main pipes are installed throughout the entire interlockings. At Tower "A" two pipe runs were installed and connected together by means of by-passes at points within the terminal area. This arrangement insures uninterrupted operation in case of repairs being made to either of these main pipes.

WIRE CONDUIT

All main and branch line conduits consist of conduit made up of yellow pine creosoted lumber, 2"x8" and 2"x12".

Lead covered cables are used exclusively for the control of all functions and these are enveloped in main and branch line conduit in three inches of clay, this practice being followed throughout the entire work. For all track connections concrete bootlegs were used.

SIGNALS

The Union Switch & Signal Company's three-position electropneumatic upper quadrant signals were used. On the terminal plant these signals have two arms, the top or medium speed arm, governing all routes within the interlocking limits, is automatically controlled, whereas the lower or call-in arm is controlled by a push button contact operated in connection woth the signal lever when the route governed by the top arm is occupied, or controlled by the lever direct when route set up is not completely track circuited, as yard tracks, etc. At Tower "C," where high speed main line running is the rule, signals are used, indicating high, medium and low speed.

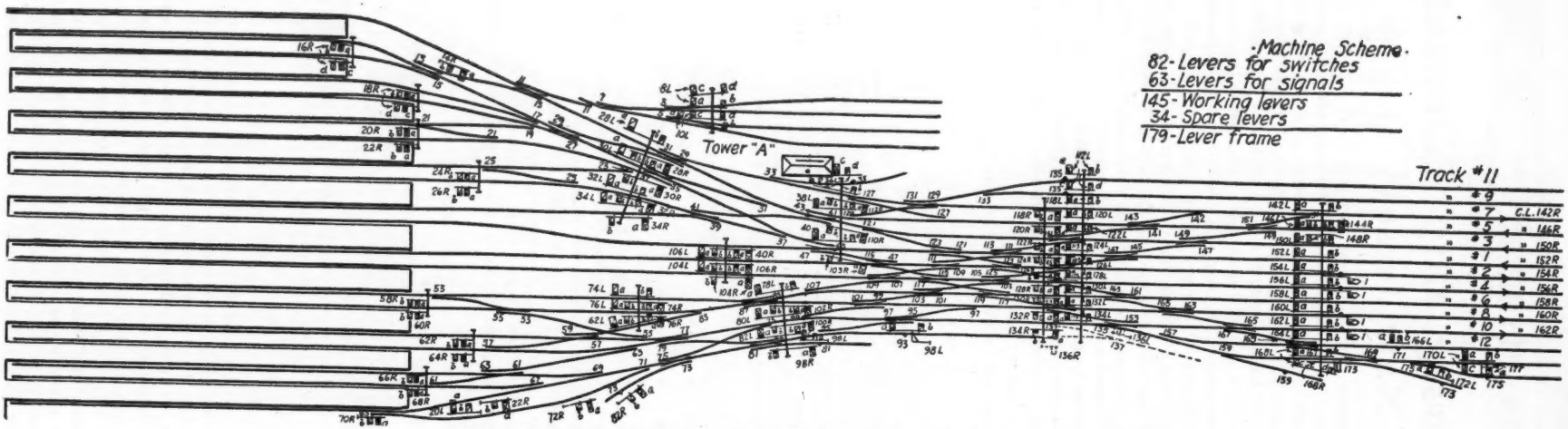


Diagram of Signals and Switches, Tower "A," C. R. R. of N. J., Jersei City Terminals.

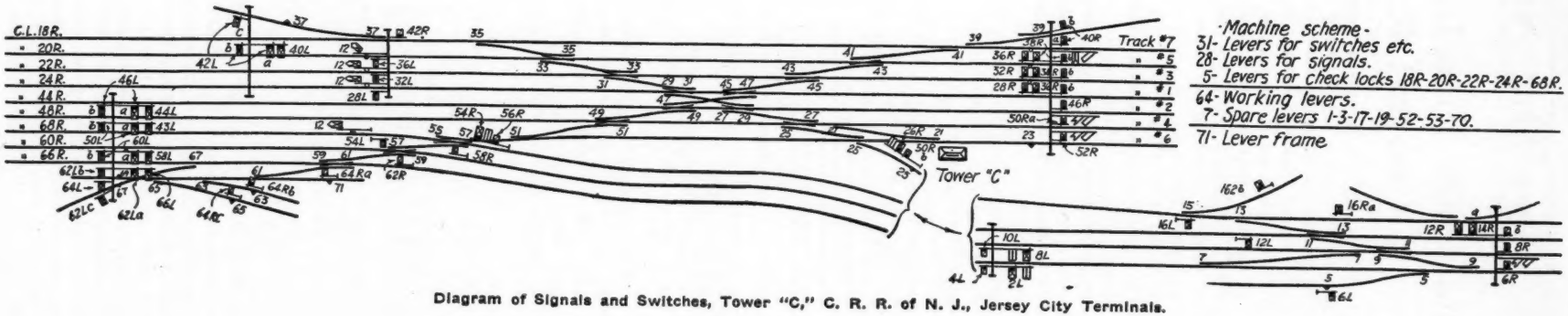


Diagram of Signals and Switches, Tower "C," C. R. R. of N. J., Jersey City Terminals.

RAILWAY ENGINEERING AND MAINTENANCE OF WAY

C.R.R.C. OF N.J.

DIAGRAM SHOWING ASPECTS OF UPPER QUADRANT SIGNALS TO BE PLACED IN SERVICE BETWEEN THE TRAIN SHED AT JERSEY CITY AND FIRST SIGNAL BRIDGES WEST OF COMMUNIPAW TOWER.

INDICATIONS

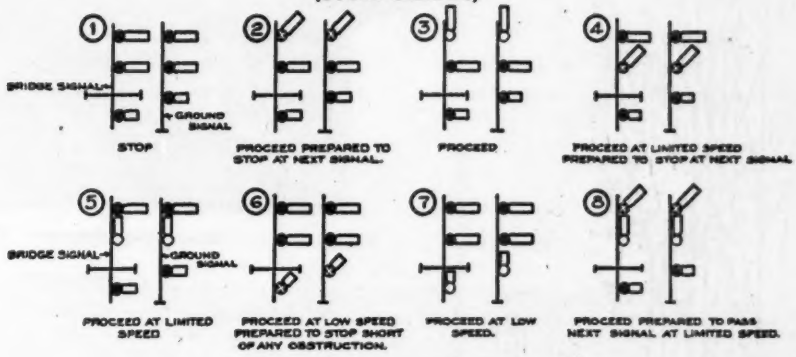
NIGHT	DAY	
COLOR	POSITION	INDICATION
Red	Horizontal = Zero	Stop
Yellow	Diagonal = 45°	Caution
Green	Vertical = 90°	Proceed.

All blades painted yellow.

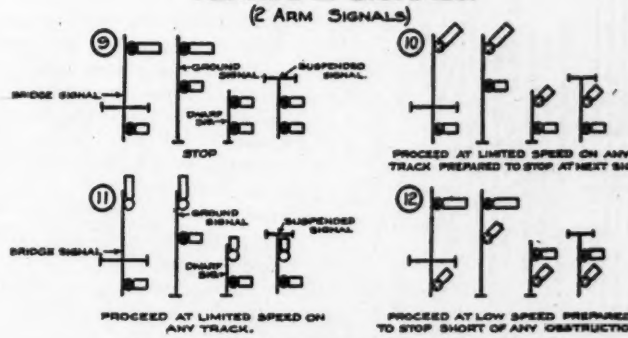
INTERLOCKING SIGNALS.

NOTE. Square end blades and vertical or single lights indicate interlocking signals.

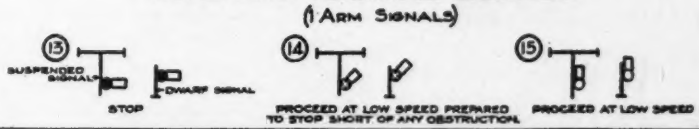
ROAD SIGNALS.
(3 Arm Signals)



TERMINAL SIGNALS.
(2 Arm Signals)



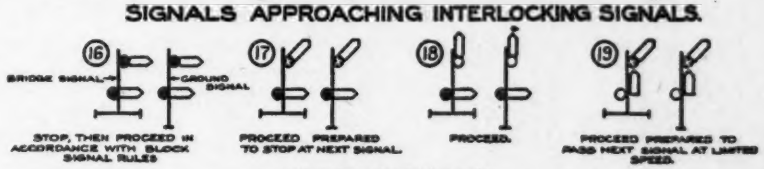
ROAD AND TERMINAL SIGNALS.
(1 Arm Signals)



AUTOMATIC BLOCK SIGNALS.

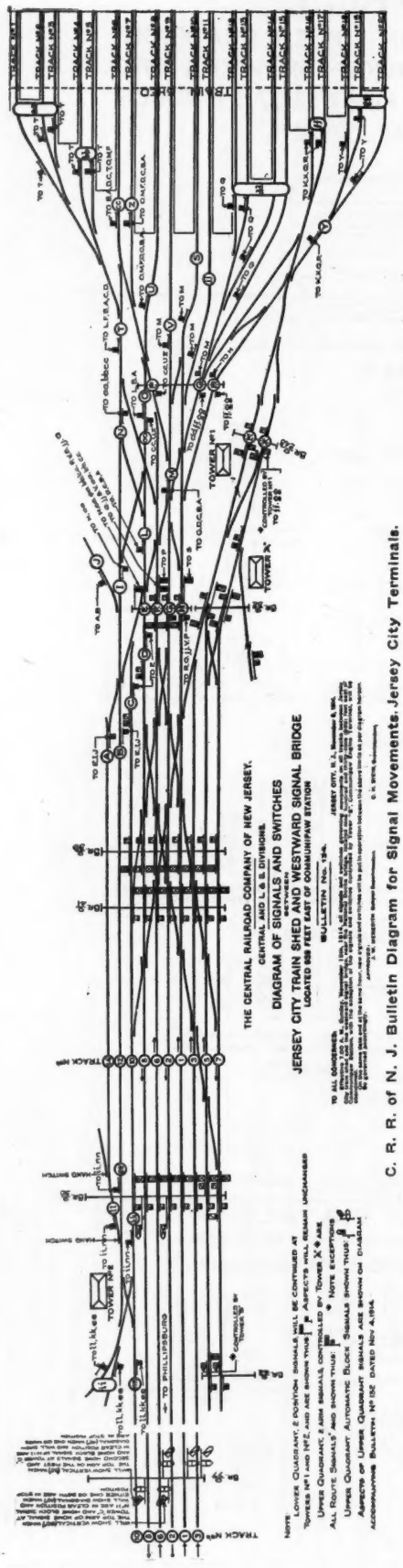
NOTE. Pointed blades and staggered lights indicate automatic block signals.

SIGNALS APPROACHING INTERLOCKING SIGNALS.

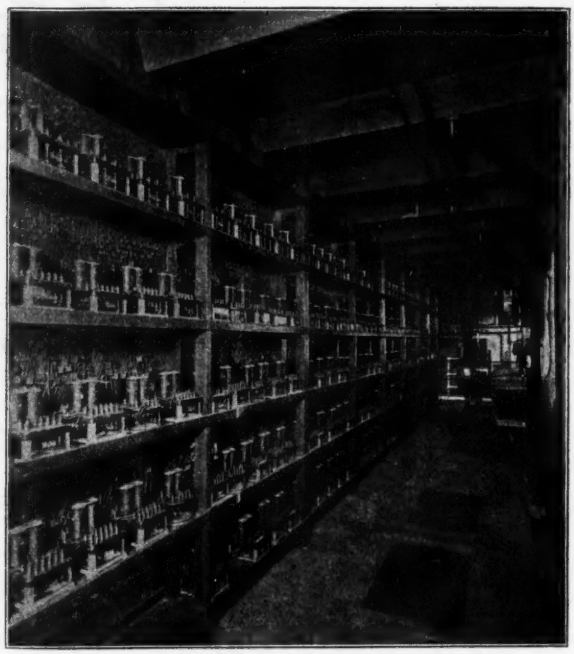


ROAD SIGNALS.

Black Indicates Red or Stop; "Cross" X Indicates Yellow or Cau tion; White Indicates Green or Proceed.



C. R. R. of N. J. Bulletin Diagram for Signal Movements, Jersey City Terminals.



Relay Room, Basement, Tower "A."

CIRCUITS

Switch detector circuits with advance route locking are used in lieu of detector bars for the locking of the switches. Approach locking with clock work time releases is used for locking all signal levers controlling signals governing in the direction of traffic entering these interlockings.

Lever light indicators were furnished for all switch and signal levers. The use of these indicators is to convey to the leverman and train director the condition of the switches and track sections within the interlocking limits and the approach thereto. The circuits for the control of all apparatus in connection with this installation were designed in accordance with the standard practice of the Union Switch & Signal Company and approved by the Signal Engineer of the railroad company.

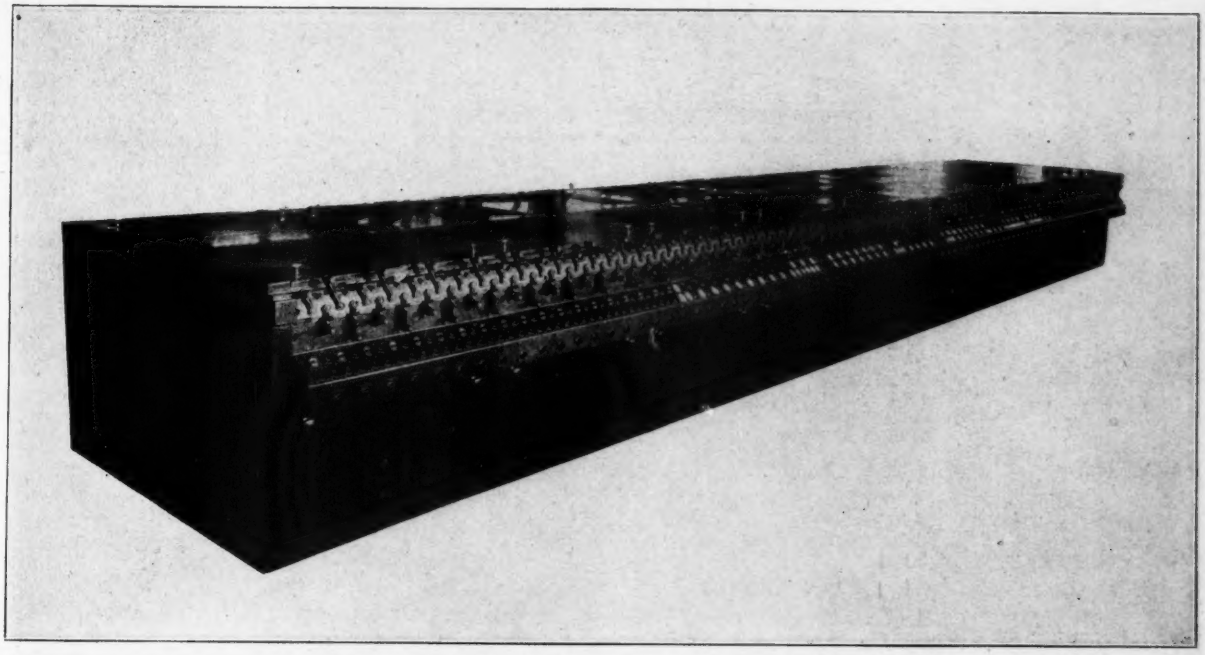
In laying out the circuits, the R. S. A. nomenclature and wire numbering system, as approved at the September 1914 convention, was used and found to be readily applicable to the varied circuit conditions encountered.

TRAIN STARTING SYSTEM

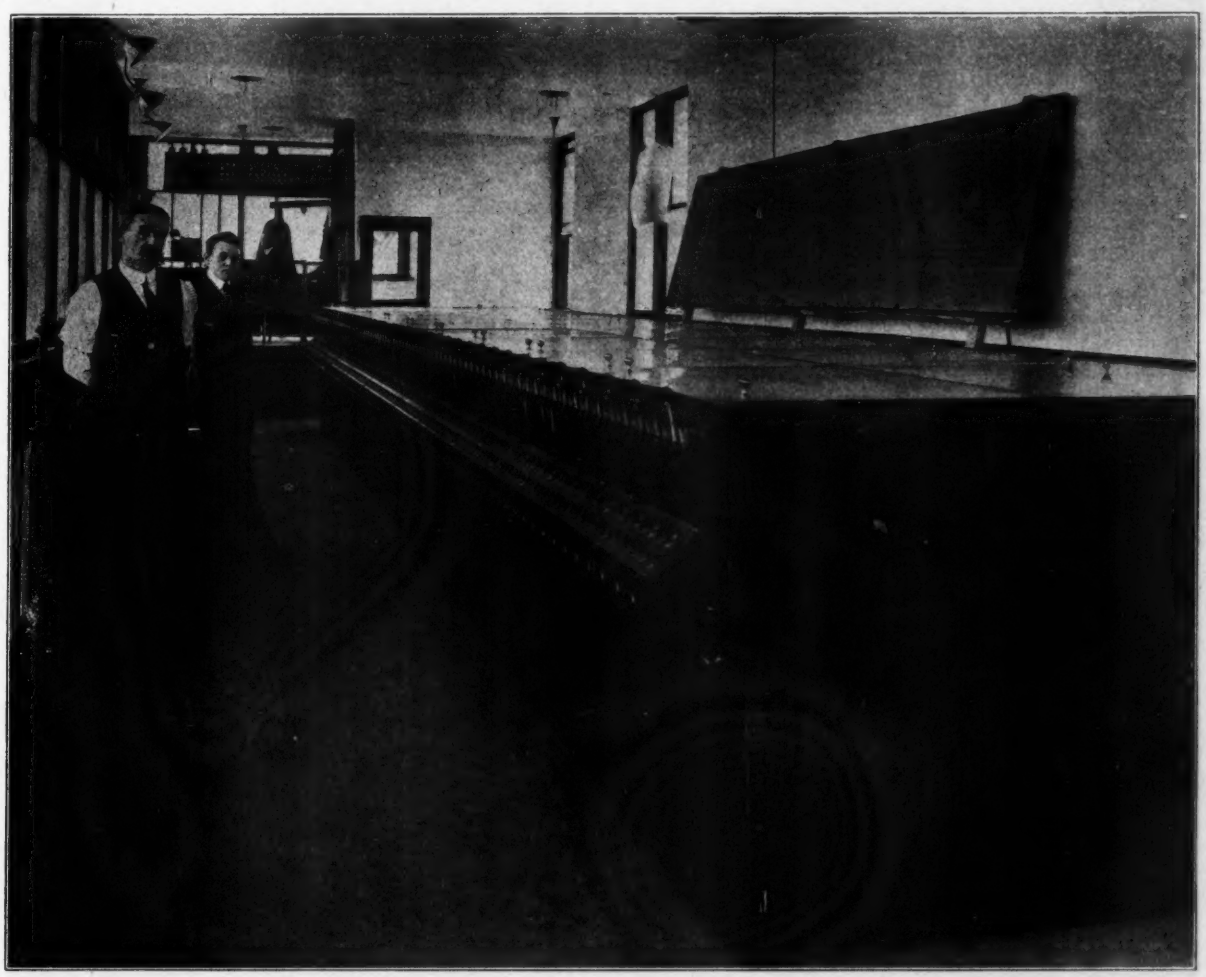
The system provides for intercommunication between the ferry-master, gateman, train conductors and towerman for the expeditious dispatching of trains. Light indicator cabinets are provided in the interlocking tower from which the switches in the station are operated, and in the ferry-master's office, from which office the ferry boats plying between the Jersey City, N. J., station and the Liberty and 23rd Street, New York, stations of the Central Railroad are dispatched. Each of these two indicators consists of 20 units—one being provided for each of the 20 train shed tracks. Three-way light indicators are provided at each gate in the concourse leading to the various train-shed tracks. These indicators are provided with one red, one green and one yellow lens. A gateman's switch is supplied for each gate, as well as a conductor's switch to be placed on the roof-supporting columns on the passenger platforms.

The system operates as follows:

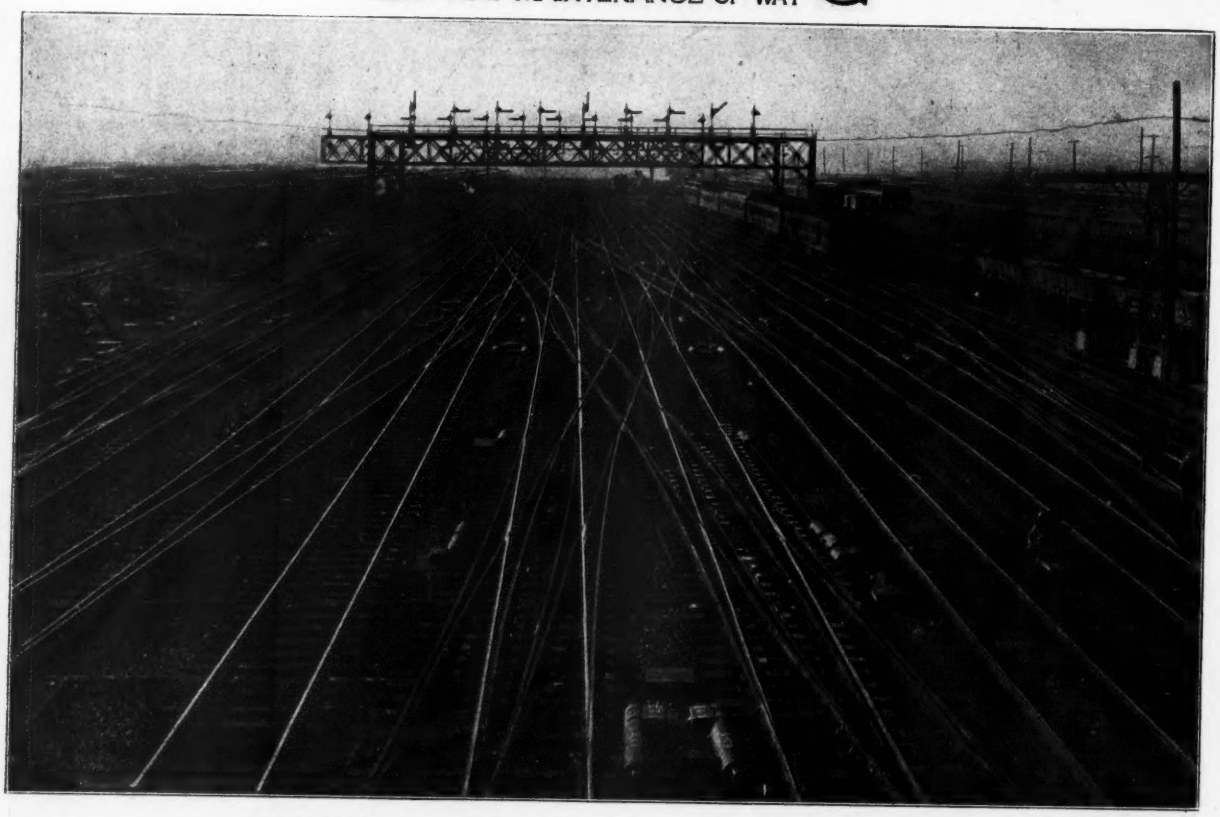
On the arrival of the last ferry-boat carrying passengers for any particular train, the ferry-master pushes a button in his cabinet which is numbered to correspond to the track on which the particular train is loading. The pushing of this button lights up indicator in the tower cabinet corresponding to the track from



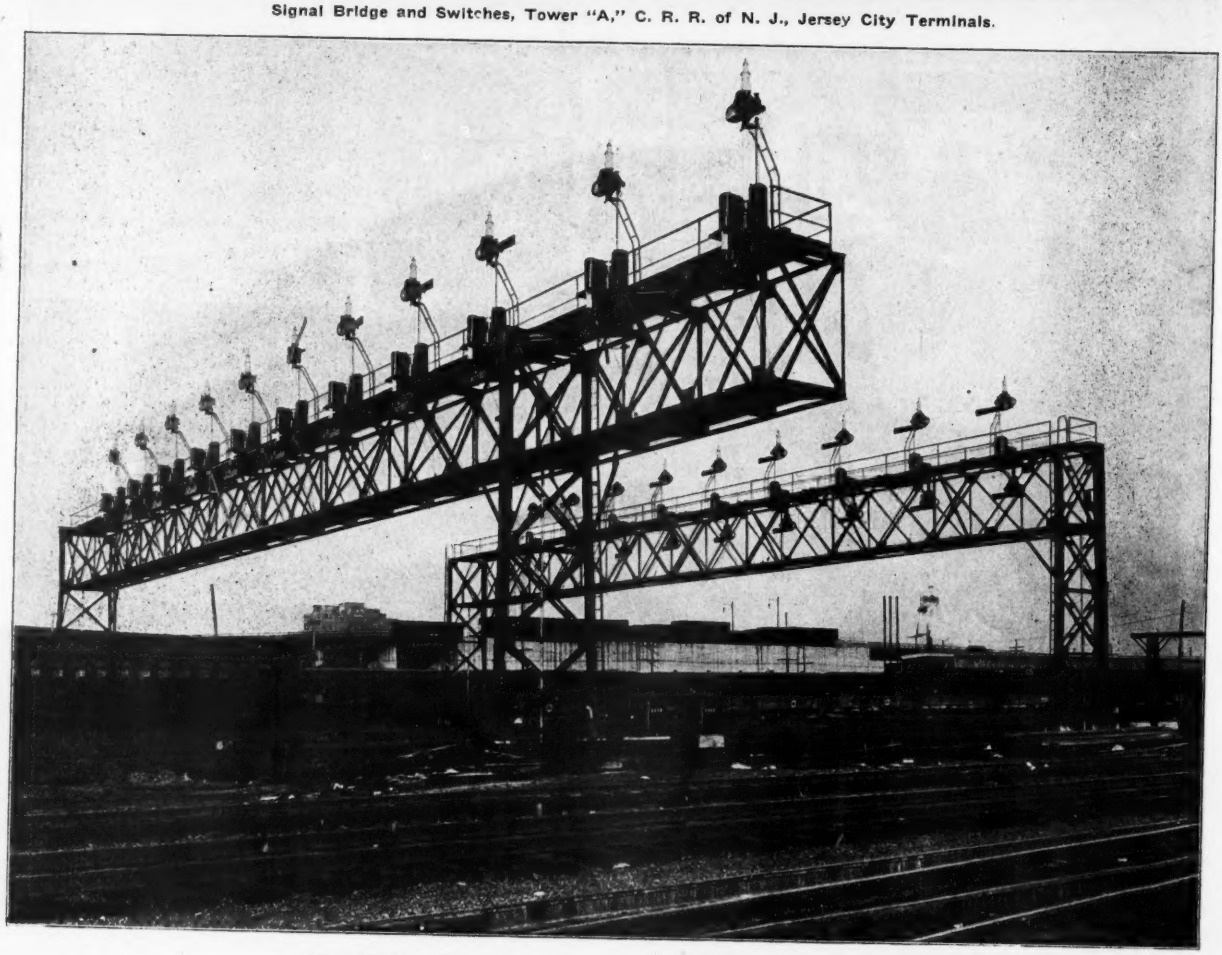
Steel Incased, Lever Lighted, U. S. & S. Co. Interlocking Machine, Tower "A."



Interlocking Machine in Place, Tower "A."



Signal Bridge and Switches, Tower "A," C. R. R. of N. J., Jersey City Terminals.



Signal Bridge, Tower "A," C. R. R. of N. J., Jersey City Terminals.

Switch Board and Storage Batteries, Tower "A," C. R. R. of N. J., Jersey City Terminals.

which the train departs, and at the same time lights up the red light in the three-way indicator at the gate through which the passengers pass to the train. This notifies the towerman, gateman and conductor that the last boat has arrived.

When the train is made up, engine attached, air tested, etc., the conductor operates his key switch located on the platform columns, thereby lighting up the green light in the gateman's indicator. This also lights the indicator in the tower cabinet, thus informing both the gateman and towerman that the train is in proper shape. The gateman after closing the gate on the passage of the last passenger through it, operates a similar key switch which lights up the yellow light in the three-way indicator and still another supplementary indicator for that particular track in the tower. The towerman is thus advised that the train will very shortly be ready to depart, so that he can set up the route and clear the signals. The conductor, also observing the yellow indication in the gate light indicator, knows that he may start the train as soon as the last passenger has boarded the train. The gate light indicators are arranged so that the red, green and yellow lights are easily observed by the train conductor on the passenger platforms. Frosted lenses are provided back of these three different colored lights so that the gateman observes the indicators from the rear, differentiating between the ferry-master's and conductor's indicator by the position of the lights. The station-master on duty in the concourse also observes the one, two or three yellow lights as illuminated in the gateman's indicator for his information as to the preparations being made for the departure of any particular train. On the departure of the train, the gateman extinguishes all lights by releasing a key switch at the gate.

BOAT STARTING SYSTEM

This system is similar to the train starting system in both operation and design, except that it controls the departure of all ferry boats.

The electrical energy available and on which the entire system operates is 110 volts 60 cycles. All wires for the system are carried through the duct lines in multiple cables.

The standard equipment of the Union Switch and Signal Company, adapted to the requirements, was installed throughout. The work was done under the general direction of President and General Manager W. G. Besler, General Superintendent J. W. Meredith, Chief Engineer Jos. O. Osgood and under the personal supervision of Signal Engineer W. H. Higgins.

CONTINENTAL BAKELITE.

The Continental Film Company of Newark, Delaware, have gotten out a new track insulator, which they designate as Continental Bakelite. This compound is for use in insulated joints or for skims to insulate the rail from metal ties. Bakelite has the faculty of not becoming saturated with water when in service.

Tests made with Continental Bakelite Insulation show, where fibre was cutting out every three or four days, the same joint insulated with Bakelite over two years ago, that the material is still there. The results of other tests made by railway officials have shown that the life of Continental Bakelite is much greater than that of ordinary vulcanized fiber.

The cost of Bakelite is greater than the ordinary fiber compounds used, but this should be offset by the increased life and less cost of maintenance labor.

Personals

The resignation of Mr. David McNicholl, vice-president and general manager of the Canadian Pacific Railway Company, through ill health, and the announcement of the appointment of Mr. George J. Bury as his successor, brings into the top ranks of railroad men a figure of unusual promise. Mr. McNicholl's resignation takes effect on January 1, next. In making the fact public, Sir Thomas Shaughnessy, president of the road, stated that Mr. McNicholl will remain on the board of directors. Sir Thomas said: "It is expected that Mr. McNicholl, when his health permits, will be asked to accept another important post in connection with the company's affairs. He retired with the esteem, and indeed affection, of the directors, officials and employees of the company."

David McNicholl.

Mr. McNicholl, who is 62 years of age, was born at Arbroath, Scotland, in 1852, and at 22 years of age entered the service of the Toronto Grey and Bruce Railway of Ontario, of which he became general passenger agent in 1882. From 1883-9 he was general passenger agent of the eastern division of the Canadian Pacific and later of the whole system. In 1899 he was appointed assistant general manager and one year later vice-president and general manager, and became first vice-president and director in 1903.

Mr. George J. Bury, who has until now been in charge of the company's interests west of Lake Superior, is a C. P. R. product all through. He is 48 years of age and began work in the purchasing department of the Canadian Pacific, passing to the operating branch. His activities have been identified chiefly with western Canada, where he was made superintendent at Fort William; then superintendent at Cranbrook, B. C.; assistant general superintendent, Lake Superior division; later general superintendent of the western lines with headquarters at Winnipeg; then vice-president and manager of western lines. He succeeded Sir William Whyte in the latter capacity.

Richard Sachse has been appointed chief engineer of the California railroad commission in San Francisco. Mr. Sachse entered the service of the commission in 1911 as assistant engineer; was promoted to the position of principal assistant engineer in 1913; and was acting chief engineer since December, 1913. Prior to his service with the commission he had been with the Western Pacific Ry., the Southern Pacific Co., and the United States reclamation service.

S. E. Hutton, consulting engineer, Moscow, Idaho, has been appointed engineer of the public utilities commission of Idaho.

Charles B. Teller has been appointed roadmaster of the Chicago, Rock Island & Gulf at Ft. Worth, Tex., to succeed B. F. Harrison, resigned.

W. E. Smith, superintendent of construction of the Louisville & Nashville R. R., has been appointed superintendent of the St. Louis and Nashville divisions, with headquarters at Evansville, Ind., to succeed John W. Logsdon, who has temporarily retired, because of ill health.

M. F. Clements, of Ridgefield, Wash., has been appointed engineer in charge of track elevation of the Northern Pacific Ry. at Spokane, Wash.

F. D. Nauman, division engineer of the Chicago division of the Baltimore & Ohio R. R., with office at Garrett, Ind., has resigned to accept a position with the Rail Joint Company of New York City. Mr. Nauman will be located at San Francisco, Cal., and will represent the Rail Joint Co. at the Panama exposition. J. E. Lloyd succeeds Mr. Nauman, effective December 1.

John W. Williams was appointed superintendent of the Globe Division of the Arizona Eastern on December 1, vice C. C. Mallard, deceased.

J. J. Hess.

J. J. Hess, assistant engineer maintenance of way of the Great Northern, with headquarters at St. Paul, has been transferred to assistant engineer maintenance of way, with headquarters at Seattle, vice P. H. McFadden, resigned to accept a position with another company.

John O'Leary has been appointed assistant engineer maintenance of way of the Great Northern, with headquarters at St. Paul, vice J. J. Hess, transferred.

The jurisdiction of G. S. Stewart, superintendent of the Spokane division of the Great Northern, has been extended over the Marcus Division, vice W. Carswell, transferred.

The jurisdiction of J. A. MacKinnon, superintendent of the Willmar Division of the Great Northern, has been extended over the Sioux City Division, vice B. Lantry, transferred.

S. L. Racey has been appointed assistant superintendent of the D. & R. G. with headquarters at Pueblo, Colo., vice E. E. Gray, transferred.

R. C. Hobbs, formerly traffic manager, has been appointed general manager of the Kansas City & Memphis, vice O. S. Lisman, with headquarters at Rogers, Ark.

P. R. Albright, assistant to the general manager, of the Atlantic Coast Line, has been promoted to assistant general manager, with headquarters at Wilmington, N. C.

L. D. Blauvelt is both chief engineer and superintendent of the Denver & Salt Lake R. R., with headquarters in Denver, Colo.

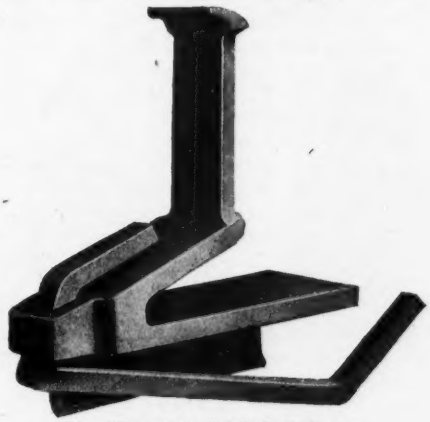
B. Lantry was appointed superintendent of the Fergus Falls Division of the Great Northern, on December 1, vice J. Lindsey, resigned on account of ill health. His headquarters are at Melrose, Minn.

With The Manufacturers

THE "ECCENTRIC GRIP" RAIL ANCHOR

Dalton Risley and Associates, 1012 Hartford Building, Chicago, have the exclusive sales agency of "The Eccentric Grip Rail Anchor." This anchor is the design and patent of B. C. Rowell, well known as one of the co-designers of the Rowell-Potter safety stop.

The anchor is scientifically designed with regard to taking up the impact of thrust by having all of its bearing surfaces in the form of an arc of a circle. The radii of these arcs are all the same, hence the leverage of thrust of all bearing surfaces is identical, which would obviate counter-thrusts that tend to loosen the anchor or throw it out of alignment from its most efficient resisting position. The method of attaching the anchor to the rail and holding it there is simple and effective. A square iron rod passes through a slot, made in an extension of the anchor where it rests on the top of rail flange, and



The "Eccentric Grip" Rail Anchor.

is permanently hooked over the top of the rail base bearing portion. This bar is allowed a small amount of vertical play, and when the anchor is applied to the rail this bar is held up against the base of the rail by a pinch-bar, a blow given the end of it with a spike maul, which hooks it over the flange of the rail on the opposite side from the anchor proper. This causes both a longitudinal and vertical lock of the anchor. A great advantage of this is the fact that the ordinary tools of the track walker are sufficient to apply the anchor at any time. The anchor is two-way and can be applied either to the right or the left.

Extensive laboratory tests have been made of the anchor, which have demonstrated that it moves one-quarter inch before getting its full "set," and that it holds far in excess of a pressure of 7,000 pounds, the accepted standard for the pressure required for the movement of an oak tie against rock ballast. These tests were conducted in the presence of several well-known railway engineers.

MANN FRONT CENTER SPREADER.

In our November issue a description of the Mann Front Center Spreader was published with illustrations. Through an error the statement was made that "material for building a bank can also be brought up from a position 8 inches below the top of the ties." This should read "from a position 8 feet below the top of the ties."—*Editor.*

Because of the war, English manufacturers and consumers of wood pulp have been caused considerable uneasiness. Production is at a standstill in the countries at war, and in Norway and Sweden, principal sources of supply, mills have been greatly hampered because of a lack of coal and of chemicals.

DIXON'S BOILER GRAPHITE.

The Joseph Dixon Crucible Company, of Jersey City, N. J., is sending out a postal card, made up in the form of a barrel, calling attention to their Boiler Graphite for use in all types of engine boilers. The card is printed in two colors and on the inside calls attention to the fact that for nearly four score and ten years the company has had at its command all forms and grades of graphite and therefore has no incentive to use or

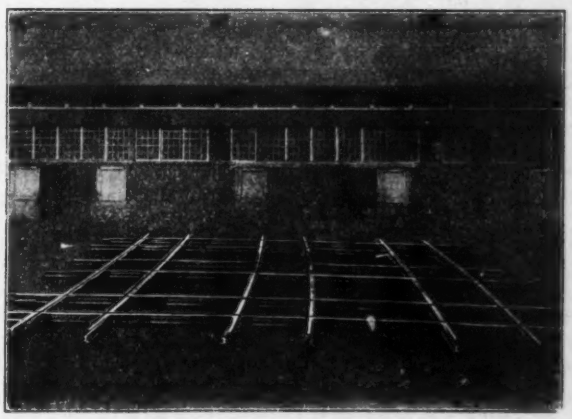
recommend other than the correct grade of Dixon's Boiler Graphite. D. B. G. is said to reduce fuel consumption, prevent the hardening of scale, give to the surface of the boilers a smooth polish, prevent pitting and make the removal of scale easy by a gentle, mechanical action. The reverse fold forms a return card bearing an invitation to write for the Dixon booklet "Graphite for the Boiler."

NEW TYPE OF REINFORCED CROSSING.

The illustration shows a set of nine crossings for steam service, including manganese closure rails, designed to meet unusually severe service conditions and installed by the Terminal Railway Association of St. Louis at the entrance to the Union Station, St. Louis.

Every passenger train which enters this station passes at least once over this crossing. As the station was for a long time the largest in the country and has thirty-two tracks in constant service, the test of both wearing qualities and structural strength of solid manganese steel railway track fixtures is an unusually severe one.

The solid crossing replaced built-up crossings with hard centers,

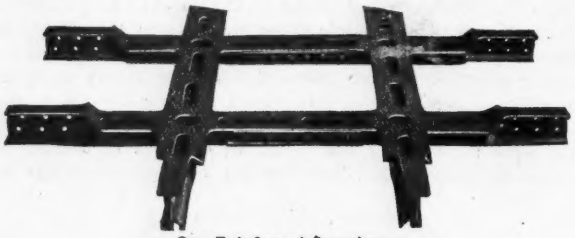


Set of 8 Reinforced Crossings.

and was installed to avoid the difficulties and expense incident to maintaining the crossing in running condition without interruptions to traffic.

An interesting structural feature embodied in these crossings has recently been patented by the builders, the St. Louis Steel Foundry Company. This is the construction of the crossings where the running surfaces intersect and there is a severe pounding action, particularly in crossings of this angle, about 90°, when the wheels jump the flangeway gap.

The pounding received by the frog points tends to bend any crossing down and subject the metal of the flangeway to a severe strain, which, being repeated several times a day, and in this



One Reinforced Crossing.

case many times per hour, tends to fatigue or "crystallize" the metal and results in failure.

To prevent this the crossings are cast as illsutrated, so that the lower flanges of the "U" merge together underneath the frog point, solidly tying the vertical webs together and taking the majority of the strains which otherwise fall upon the metal of the flangeways.

Efforts to reinforce at this point by making the crossing sections of the metal very heavy have been unsuccessful, due to unequal cooling strains and tendence to segregations, and it is this which makes the construction above described of particular importance.

The Union Station crossing and a hundred or more others with similar reinforcement have now been in service long enough (over a year) to indicate the value of the new form of construction.

ATTACKS U. S. DECISION CUTTING RAIL TARIFFS.

By a Manufacturer.

The rustiest tramp steamer that sails the seas may advance its charter rates to meet the exigencies of war transport, but American railways that forward its cargo from the granaries of the west must starve before they can advance their rates one cent.

Of the hundreds of millions that Europe, in the next six months, must pay into the pockets of the neutral citizens of the United States, not one cent will pass into the relief fund for American railways if the interstate commerce commission can prevent it.

ATTACKS SUSPENSION ORDER.

That, and only that, is the interpretation of its order suspending the tariffs of western roads advancing rates on grain and meat products after office hours on the last day when the suspension guillotine could work.

Let the American public judge of the animus and effect of this latest evidence of the commission's chronic hostility to the great industry whose interests it was organized to regulate and protect.

In accordance with their interpretation of suggestions made by the commission itself, the western railways on Oct. 28 last filed tariffs effective Dec. 1, increasing the rate on all grains and grain products, such as flour, feed, etc., 1 cent for each 100 pounds. This amounted to an increase of from 5 per cent to 8 per cent on the existing rate and nowhere approached the absurd figures given out in Washington and Chicago.

HAD SLIGHT EFFECT.

On each bushel of wheat it amounted to three-fifths of a cent; on corn, slightly over half a cent a bushel; on oats, one-third of a cent a bushel; on barley, less than half a cent a bushel, and on rye the same as corn.

Whatever it amounted to, it would be paid by the ultimate consumer whether necessitous belligerent abroad or peaceful American at home. Moreover, these new tariffs did not increase the actual rates above those already approved by the commission in the territory northwest of Chicago.

On Oct. 29 the western railways filed other tariffs effective Dec. 1, increasing the rates on packing-house products and dressed meats 3½c for each 100 pounds between Missouri River points and Chicago. This amounted to an increase of approximately 13 per cent on the old rate and not 30 per cent to 40 per cent, as was erroneously given out in Washington and Chicago. To the consumer of meat it meant an increase of 7/200 of a cent a pound, an amount so small that even the Chinese have no coin equivalent for it.

Compare these small advances with the boom in the prices of all these products since the war broke out in Europe:

Per bushel	July 15.	Nov. 15.	Advance in cents
Wheat, winter	$ .79¼	$ 1.15½	$ .36¼
Wheat, spring	.86	1.10	.22
Corn	.69¾	.74½	.04¾
Oats	.38½	.49¾	.11¼
Barley	.52	.71	.19
Rye	.58½	1.05	.46½
Per 100 pounds—			
Cattle	9.90	10.75	.85
Calves	11.00	11.25	.25
Sheep	8.85	9.25	.40

Think what these advances mean to American farmers! Then remember that it is only through the efficiency of the railway carriers that these products can reach cheaply and rapidly either the domestic consumer or be carried to the seacost for export. Finally bear in mind that the consumer, whether in Europe or America, pays the freight, and then figure out if you can upon what principle of public policy the Interstate Commerce Commission at the instigation of a few interested shippers interposed a belated order of suspension between the railways and a small but imperatively necessary advance in rates.

The manner of ordering the suspension was in keeping with its spirit. Last Monday night the traffic managers of Chicago and the west after waiting in suspense all day for word from Washington closed their desks with many expressions of satisfaction that at last the commission had permitted one small but important advance to pass unsuspended.

They retired to dream of a new and better era of railway regulation, where rates should be reduced or raised to fit the necessities of the service and the market. They awoke next morning to realize that the commission had no intention to permit the railways to share in any profit the farmers and traders might make out of the necessities of Europe.

The question for the American people to ask themselves is, "Why should every other interest in the United States be in a position to profit by the calamitous war in Europe, while the railways, upon whose efficiency all our industries depend, are not granted any share in the profits of feeding the belligerents?"

WILLIAM F. BAUER, assistant manager of the railway department of the Edison Storage Battery Company, Orange, N. J., has been appointed manager of the Chicago office, succeeding Charles B. Frayer.

Over 33,000,000 passengers carried over its line without a fatality to a passenger is the record made by the Chicago & North Western railway during the year ended June 30, 1914. This achievement—an illustration of the success of the safety first movement—was accompanied by an increase in the number of travelers carried, as compared with the year before, of nearly a million, or 2.92 per cent.

The total was 33,389,428, the equivalent of over one-third of the population of the United States, as compared with 32,441,450 in 1913, which also represented a large increase over the preceding years.

The total mileage traveled by the Chicago & North Western railway passenger trains during the year was 21,537,781, or nearly one thousand times the distance around the earth.

That this record should have been accomplished by the railway which leads in the safety movement is a source of satisfaction to the company's officials.